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Chap2-93.01
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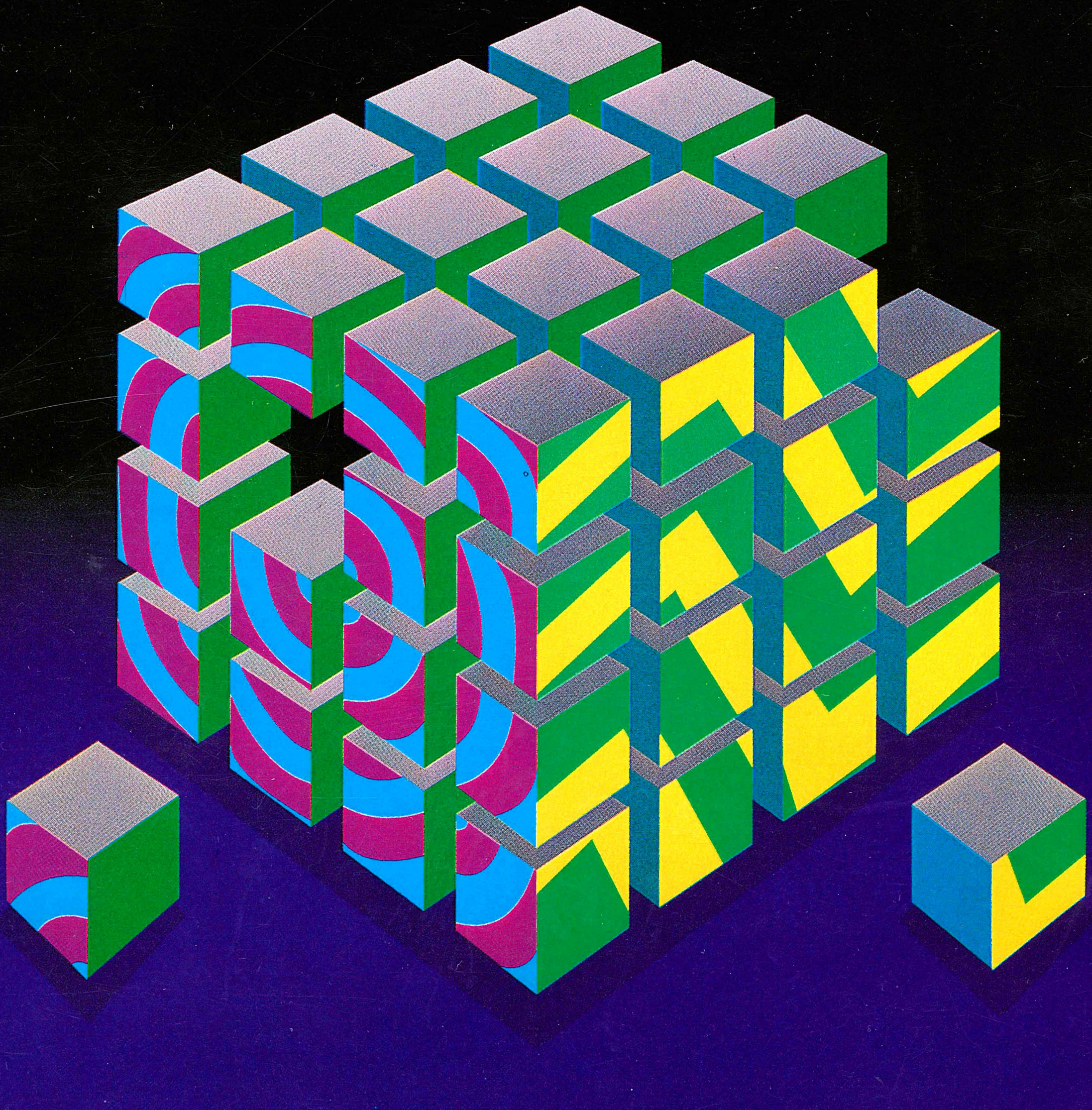
Silver Burdett
MATHEMATICS

Grades 5–6

Strategies for Problem Solving II



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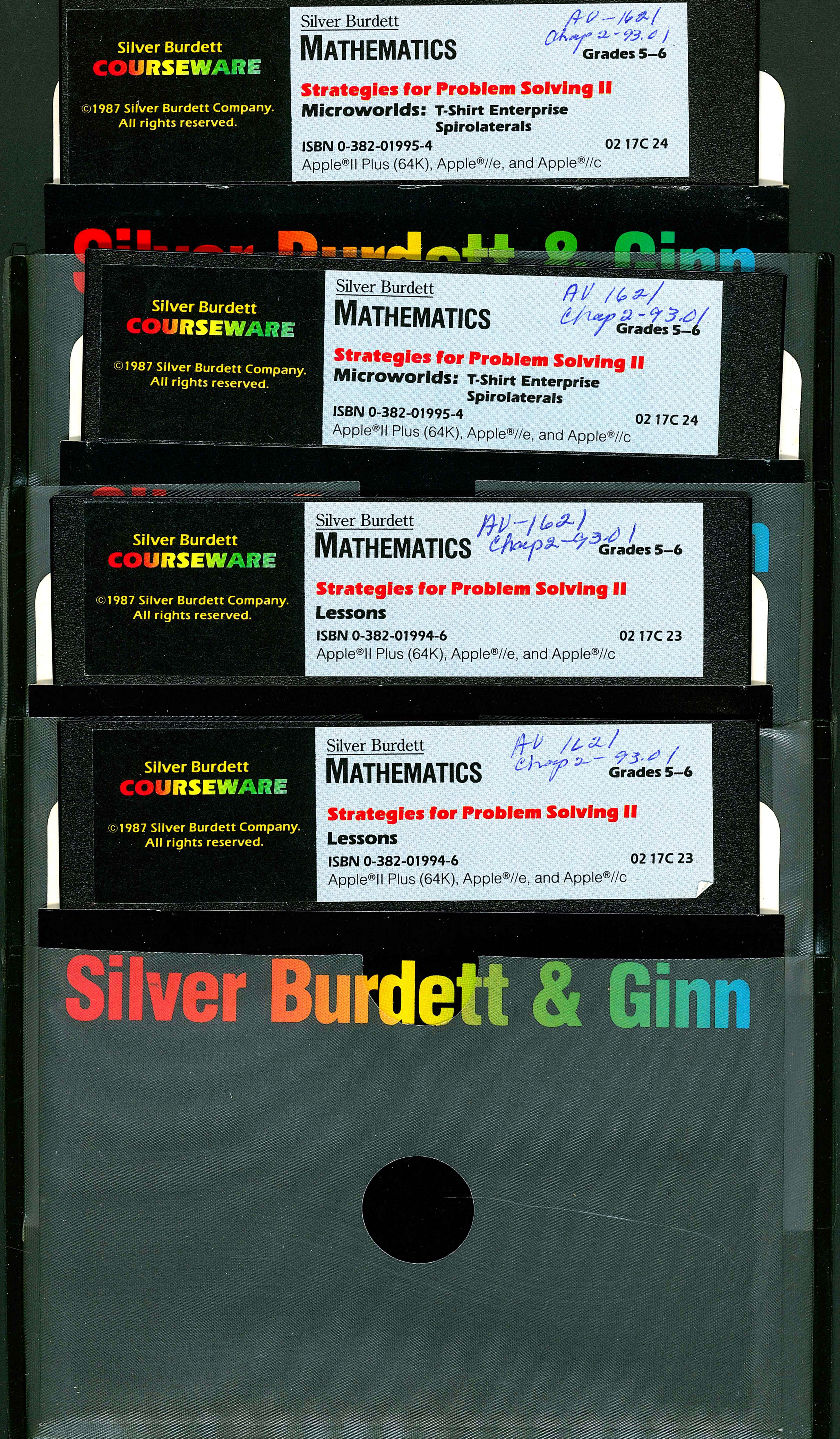

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MATHEMATICS
AV-1621
Chap 2-93.01
Grades 5–6

Strategies for Problem Solving II
Microworlds: T-Shirt Enterprise
Spirolaterals

ISBN 0-382-01995-4 02 17C 24
Apple®II Plus (64K), Apple®//e, and Apple®//c

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Strategies for Problem Solving II

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Silver Burdett
MATHEMATICS

Grades 5–6

Strategies for Problem Solving II

Developed with Information Technology Design Associates, Inc.

Silver Burdett
COURSEWARE

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TO THE TEACHER

Congratulations! You've found the math program that you've been looking for!

Silver Burdett *Strategies for Problem Solving II* courseware provides review and practice in mathematics problem-solving concepts to students at grade levels 5 and 6. The courseware also can serve as a valuable aid when you are introducing problem-solving concepts to students with little or no background in this area.

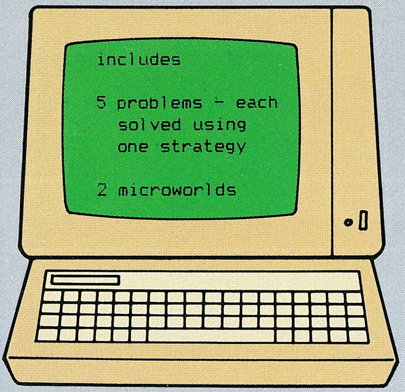
Silver Burdett *Strategies for Problem Solving II* is intended for use in conjunction with your existing mathematics curriculum. The courseware is directly correlated with the Silver Burdett Mathematics textbook series, but it also is equally applicable to other mathematics texts since it introduces and reinforces problem-solving concepts common to most mathematics curricula.

Your students can gain a sense of personal accomplishment through completing the lessons and practice problems included in Silver Burdett *Strategies for Problem Solving II*. Each student can work independently at the computer, progressing at his or her own pace. The step-by-step lesson format guides the student through the process of using a specific strategy to solve a problem that is both intellectually and visually stimulating.

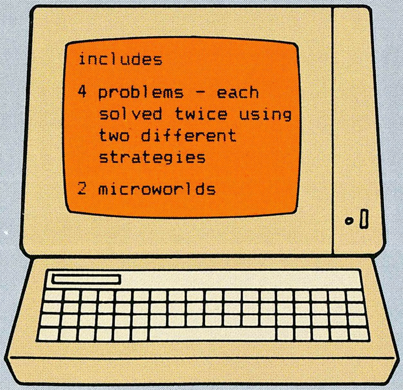
Once the student has mastered the problem-solving strategies presented in the lessons, he or she is challenged to apply these strategies to problem situations presented in two microworlds. The outcome of each situation depends on how well the student uses the strategies.

This Courseware Guide provides detailed information about introducing and using Silver Burdett *Strategies for Problem Solving II*. Read the guide carefully to enhance enjoyment and satisfaction of the courseware by you and your students.

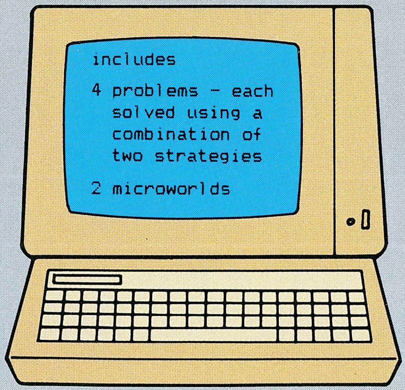
Strategies for Problem Solving I Gr. 3–4


includes
5 problems - each solved using one strategy
2 microworlds

Strategies for Problem Solving II Gr. 5–6


includes
4 problems - each solved twice using two different strategies
2 microworlds

Strategies for Problem Solving III Gr. 7–8

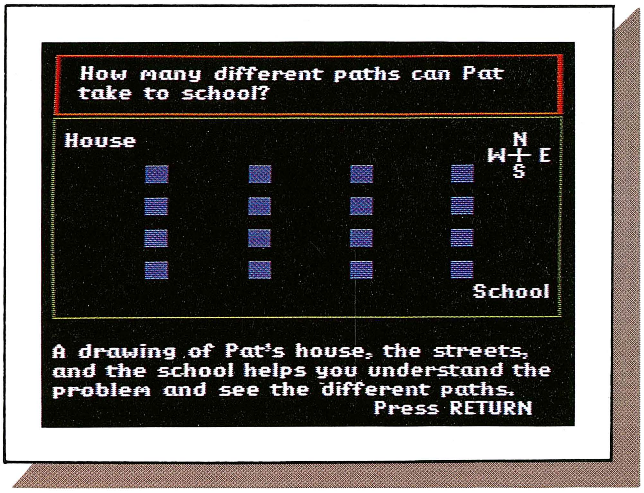

includes
4 problems - each solved using a combination of two strategies
2 microworlds

Strategies for Problem Solving II is one of a series of problem-solving courseware programs supporting Silver Burdett Mathematics textbooks.

PROGRAM FEATURES

Silver Burdett *Strategies for Problem Solving II* provides lessons, review, and reinforcement in problem-solving concepts within a sound pedagogical format for students at grade levels 5 and 6. Students achieve and strengthen understanding of specific concepts in three ways: (1) by participating in step-by-step lessons that introduce and explain individual concepts through a guided problem-solving experience, (2) by solving practice problems directly correlated with those presented in the lessons, and (3) by selecting and applying appropriate problem-solving strategies in the microworld portions of the courseware. ***Strategies for Problem Solving II*** has these characteristics and special features:

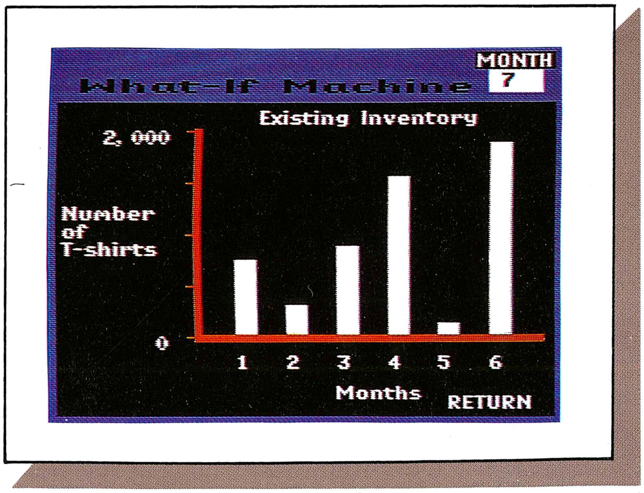
- Direct correlation with the problem-solving skills presented in the Silver Burdett Mathematics textbook series and with those typically introduced within other fifth- and sixth-grade mathematics curricula
- Step-by-step lessons that introduce specific skills and guide students through independent application of each skill to a particular problem
- Practice problems that give students additional experience in applying skills presented in the lessons
- Microworlds that enable students to extend application of the skills taught and reinforced in the lesson and practice portions of the courseware
- Clear instructions that most students can follow independently
- HELP screens that aid students in the problem-solving process
- Pacing that is controlled by the student and that ensures the flexibility demanded by the variance in learning styles among students
- Positive reinforcement and feedback in response to student performance
- Careful balance of graphics and text
- Use of uppercase and lowercase letters to ensure easy readability
- Fail-safe operation that disables other keyboard options when specific responses are required



How many different paths can Pat take to school?

A drawing of Pat's house, the streets, and the school helps you understand the problem and see the different paths.

Paths lesson screen



T-shirt enterprise graph

CORRELATION WITH SILVER BURDETT MATHEMATICS TEXTBOOK SERIES

The chart below lists the problem-solving strategies reinforced by ***Strategies for Problem Solving II*** and the chapters in SILVER BURDETT MATHEMATICS in which those strategies are introduced or reviewed.

SILVER BURDETT MATHEMATICS CORRELATION						
Strategies for Problem Solving II Disk	**Textbook Chapters**					
Strategies	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Patterns	5, 6	12	8	7	9	4
Divide and Conquer	7	7	6	4	5	5
Guess and Test	13	9	5	5	7	12
Solve a Simpler Problem			9	9	10	14
Making a List		6	11	10	13	9
Working Backwards			13	11	4	10
Logical Thinking			7	8	12	8, 11
Simulation	12	11	14	14	3	3

TEACHING STRATEGIES

How you incorporate ***Strategies for Problem Solving II*** into your mathematics curriculum depends on your teaching style and the goals you have established for students.

Refer to the chart above for a correlated list of the strategies reinforced by the courseware and the chapters in SILVER BURDETT MATHEMATICS in which the strategies are introduced or reviewed. ***Strategies for Problem Solving II*** is equally applicable to other mathematics texts since it introduces and reinforces strategies common to most mathematics curricula.

These are some options for using the courseware in conjunction with your existing mathematics curriculum:

1. Use the appropriate lesson and practice to reinforce a strategy soon after you have taught it.
2. Use the appropriate lesson to introduce a strategy before you teach it. Following classroom instruction, use the lesson and its correlated practice to review and reinforce the strategy.
3. Use the lessons and practices to review strategies taught and mastered in previous weeks, months, and years.
4. Use the microworlds to challenge students who have mastered the strategies.
5. Use the microworlds to motivate students who need practice in applying problem-solving strategies but seem unwilling to practice in more traditional ways.

EQUIPMENT NEEDED

To use ***Strategies for Problem Solving II*** you will need an Apple II Plus (64K including language card), Apple //e, or Apple //c computer; color or monochrome monitor or TV; 1 or 2 disk drives.

CARE OF COMPUTERS AND DISKS

You'll want to place your computers where the students using them will not be disturbed and where their use will not distract other students. Place computers away from direct sunlight, chalkboards, sinks, radiators, and heat ducts. To minimize carpet-induced static electricity, which can damage delicate electronic equipment, you can spray carpeting with a commercial antistatic product or a mixture of fabric softener and water. You might also purchase an antistatic mat. Advise your students to touch something metal before beginning to work at the computer. This will release any of the static charges they may be carrying.

It would be advisable to load the disk yourself when the students are first learning to use ***Strategies for Problem Solving II***. Then let your students practice loading with a blank disk until you are sure that they can handle disks carefully. You may wish to open a defective disk to show curious students how disks are made.

COMPONENTS

The Disks

Two program disks and two duplicate (backup) disks are included in the SILVER BURDETT ***Strategies for Problem Solving II*** courseware package. Each 5¼-inch floppy disk is intended for use with an Apple II Plus (64K including language card), Apple //e, or Apple //c computer. The programs produce colorful graphics when displayed on a color monitor, and they also operate effectively on a monochrome monitor.

The Courseware Guide

Before SILVER BURDETT ***Strategies for Problem Solving II*** is introduced in the classroom, the Courseware Guide should be studied thoroughly. The guide provides information about how the programs work, how they can help students learn, and how they can make problem solving enjoyable.

Copy masters are also included in the Courseware Guide. The copy masters, which include activity sheets designed to complement the courseware, may be reproduced directly or used to make spirit masters for duplication.

The Courseware Guide also includes general information about the proper care of computer equipment and disks and concise program loading instructions.

PROGRAM OBJECTIVES

Each lesson in this program is designed to show pupils how to use a specific strategy to solve a problem. Four problems are presented in the lesson portions; pupils learn to solve each of the four problems, using two different strategies. A practice section follows each lesson, giving pupils opportunities to practice, using each strategy.

Upon completion of the lesson and practice portions of the *Strategies for Problem Solving II* program, the pupil will be able to do the following:

- **Determine the question to be answered to solve a problem.**
- **Use a chart or table to solve problems.**
- **Use facts from pictures and text to solve problems.**
- **Use a drawing to solve problems.**
- **Solve problems using the following strategies:**

1. Divide and Conquer
2. Patterns
3. Simulation
4. Guess and Test
5. Making a List
6. Working Backwards
7. Logical Thinking
8. Solve a Simpler Problem

The microworlds portion of the *Strategies for Problem Solving II* program gives pupils opportunities to apply strategies they develop in the lesson and practice portions of the program. Individual pupils may apply different strategies to solving the problems presented in the microworlds. Upon completion of the microworlds, the pupil will be able to do the following:

- **Choose the strategy to solve problems.**
- **Use a graph or chart to solve problems.**
- **Use one or more of the eight problem-solving strategies to solve problems.**

LESSON DISK

Lessons

The lesson disk for ***Strategies for Problem Solving II*** contains eight step-by-step lessons, each accompanied by opportunities for practice. The lessons and practice problems are grouped into four sets: Duets, Crossnumber Puzzles, Find the Rule, and Paths. The focus of each set is a common problem with changing facts that is solved using two different strategies. Menus provide options for students to repeat a lesson before continuing to the practice problem.

Each lesson involves students in an independent, interactive learning experience related to a specific problem-solving strategy. At the beginning of a lesson, students are introduced to the question in the problem, the facts in the problem, and the steps involved in applying the problem-solving strategy. These steps are then followed within the format of the lesson. Throughout a lesson, students are continually guided to ensure that they realize progress and avoid frustration.

Practice

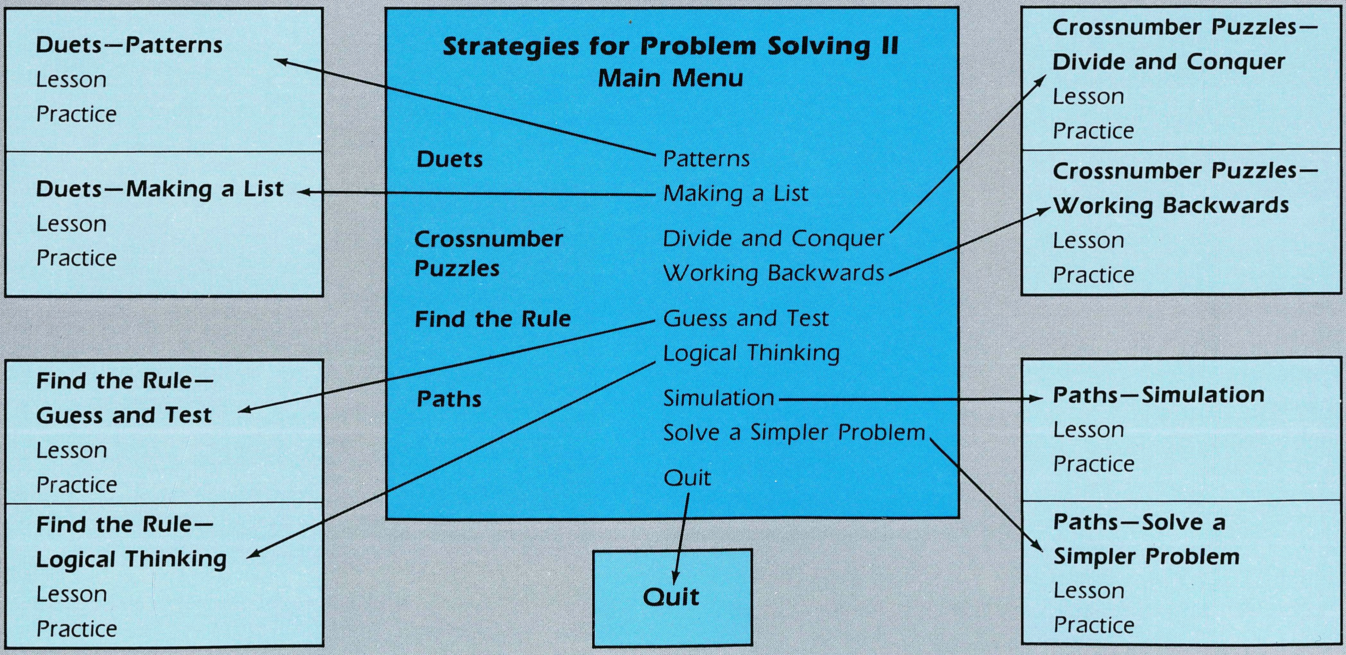
The practice accompanying each lesson presents a problem similar to that solved within the lesson. Unlike the paced lesson, however, the practice offers students the opportunity to apply the problem-solving strategy and solve the problem independently. Optional HELP screens are available.

Instructions that students need in order to work through the lessons and practice problems are included in the program.

The content and rationale of the lessons and practices are summarized in the sections that follow. The lessons and practices are described in the order of their appearance on the Main Menu of the lesson disk.

LESSON DISK STRUCTURE

The diagram below shows the general structure of the ***Strategies for Problem Solving II*** program by indicating where each selection from the Main Menu of the lesson disk leads.



Strategies for Problem Solving II
Main Menu
Duets
Patterns
Making a List
Crossnumber Puzzles
Divide and Conquer
Working Backwards
Find the Rule
Guess and Test
Logical Thinking
Paths
Simulation
Solve a Simpler Problem
Quit
Duets—Patterns
Lesson
Practice
Duets—Making a List
Lesson
Practice
Find the Rule—Guess and Test
Lesson
Practice
Find the Rule—Logical Thinking
Lesson
Practice
Crossnumber Puzzles—Divide and Conquer
Lesson
Practice
Crossnumber Puzzles—Working Backwards
Lesson
Practice
Paths—Simulation
Lesson
Practice
Paths—Solve a Simpler Problem
Lesson
Practice
Quit

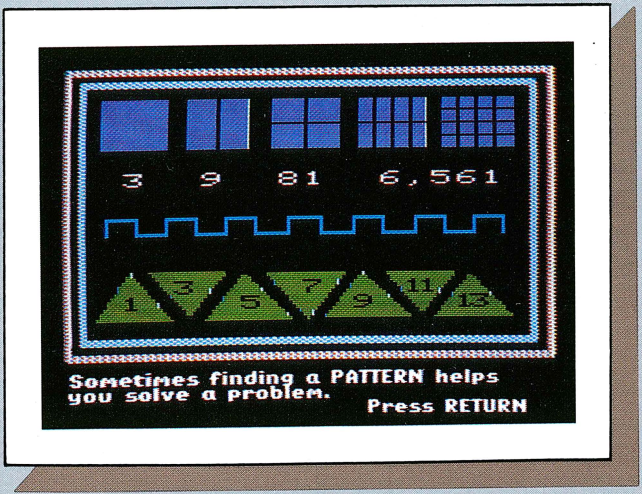
DUETS: Patterns

Lesson

In this lesson, students find and use patterns to solve a problem. The problem is presented, followed by the steps that the students will use to apply the strategy of finding a pattern to solve the problem.

Students are introduced pictorially to five musical instruments, which appear in a row across the top of the screen. Students solve the problem, using fewer instruments, beginning with one. Using a table, they enter the number of different duets possible with one instrument (zero). Students continue this procedure until tabular data for four musical instruments have been entered. Guided by text and graphics, students can begin to see a number pattern appear that can be used to solve the problem.

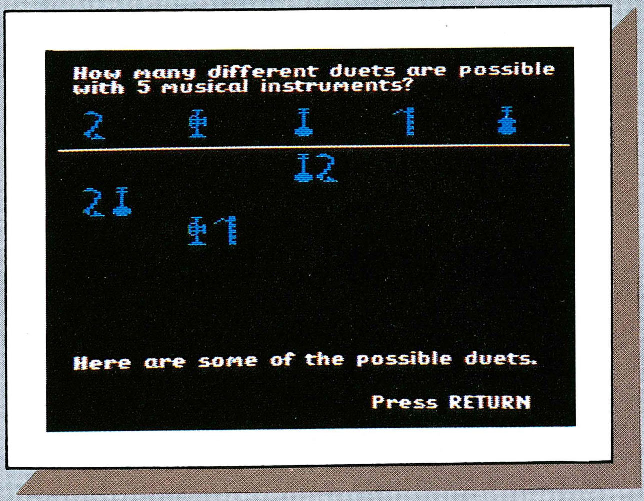
When students complete the lesson, they receive a reward screen. The lesson concludes with a menu screen that presents these options to students: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.



Sometimes finding a PATTERN helps you solve a problem.

Press RETURN

Explanation of patterns



How many different duets are possible with 5 musical instruments?

Here are some of the possible duets.

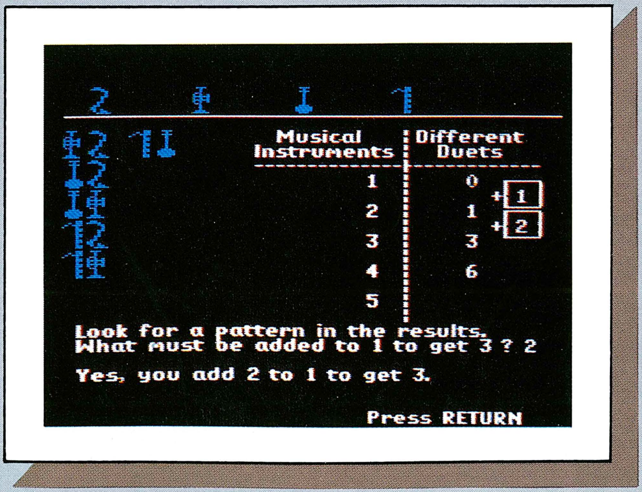
Press RETURN

Possible duets

Practice

With the selection of option 1 from the menu at the conclusion of the lesson, the first screen of the Patterns practice appears. The problem in this practice is identical in rationale to that solved in the lesson; however, the students are able to select the number of friends who play different musical instruments. Students may then proceed through the steps learned in the Patterns lesson, and they may access HELP screens when necessary.

With the choice of option 2 from the menu at the conclusion of the lesson, the first screen of the Duets: Making a List lesson appears. (This lesson is described in the next section.)



Musical Instruments	Different Duets
1	0
2	1
3	3
4	6
5	

Look for a pattern in the results.
What must be added to 1 to get 3 ? 2

Yes, you add 2 to 1 to get 3.

Press RETURN

Number pattern

DUETS: Making a List

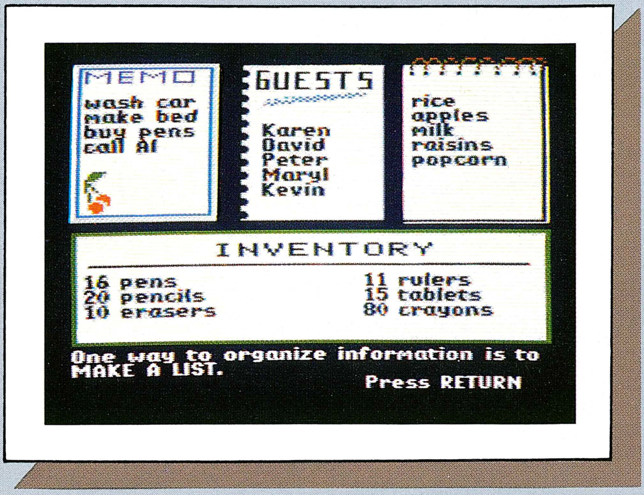
Lesson

In this lesson, students make a list to solve the same problem as in the Duets: Patterns lesson. The lesson begins with an explanation of the strategy of making a list. Next, the steps in solving a problem while using the strategy of making a list are presented, and students follow these steps to solve the problem.

As in the Duets: Patterns lesson, students are introduced pictorially to five musical instruments. Students learn that many duets are possible with five instruments. Students then proceed to organize the possible duets by making a list. They begin by viewing a pictorial list of all duets that include the saxophone. The next screen presents a list of all duets that include the trumpet, adjacent to the saxophone list. Students are asked to check the two lists to determine whether any duets are the same, and they indicate the two duets that are the same by pressing the SPACE BAR to highlight them. The second duplicate duet is crossed out but remains on the screen.

Lists for the remaining instruments are then compiled and checked for duplicate duets by the students. When the organized list is complete, students count the duets that are not crossed out, thereby solving the problem and receiving a reward screen.

The menu at the conclusion of the lesson presents these options to students: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.



MEMO
wash car
make bed
buy pens
call Al

GUESTS
Karen
David
Peter
Maryl
Kevin

rice
apples
milk
raisins
popcorn

INVENTORY
16 pens
20 pencils
10 erasers
11 rulers
15 tablets
80 crayons

One way to organize information is to MAKE A LIST.

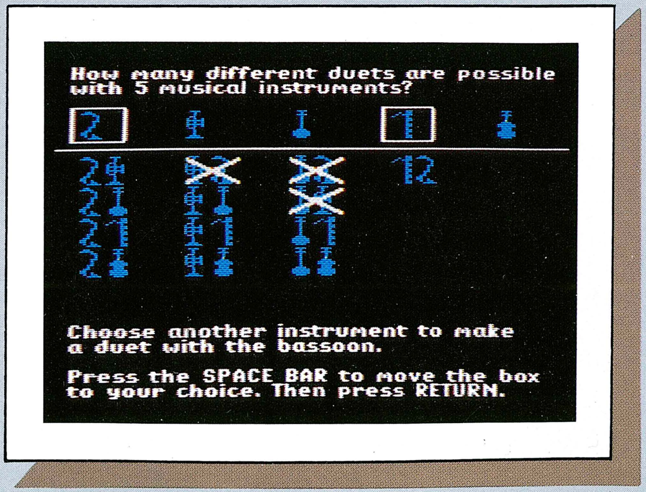
Press RETURN

Explanation of making a list

Practice

Selection of option 1 from the menu at the conclusion of the lesson, gives students access to the Making a List practice. The practice problem is identical to the lesson problem; however, students are able to select the number of friends who play different musical instruments. Students then proceed through the steps learned in the Making a List lesson and can access HELP screens when necessary. After all possible duets for one instrument are listed, students may check the list and indicate duplicate duets to be crossed out. When students believe the organized list is complete, they count the duets not crossed out and enter the total of possible duets to solve the problem.

Students choosing option 2 from the lesson's concluding menu access the first screen of the Duets: Patterns lesson. (This lesson is described in the preceding section.)



How many different duets are possible with 5 musical instruments?

Choose another instrument to make a duet with the bassoon.

Press the SPACE BAR to move the box to your choice. Then press RETURN.

Listing duets

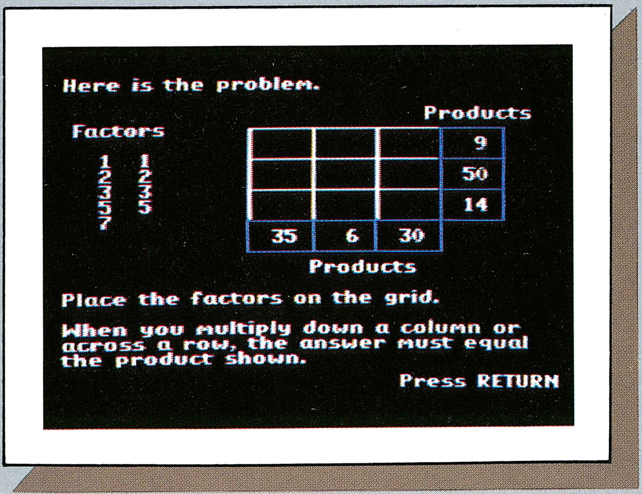
CROSSNUMBER PUZZLES:
Divide and Conquer

Lesson

Students first learn that *divide and conquer* means "to break the problem into smaller parts and then solve each part." Next they preview the steps they will follow in using the strategy to solve the problem.

The question in the problem is defined as follows: How can the factors be placed on the grid to equal the products shown? Students select the facts that help answer the question from among given answer choices.

Next, the students are guided in working the problem. They are instructed to work with only one factor at a time, starting with the largest factor (7) and ending with the smallest factor (1). First, they select the factor 7. Second, they study the grid to find each product having 7 as a factor, and highlight each by pressing the SPACE BAR. Third, they use the SPACE BAR to move the 7 into the proper cell on the grid. The two factors of 5 are then placed on the grid using the same method.



```
Here is the problem.
                                    Products
 Factors
                    |    |    |    |  9 |
   1  1             |    |    |    | 50 |
   2  2             |    |    |    | 14 |
   3  3             | 35 |  6 | 30 |
   5  5                Products
   7

Place the factors on the grid.

When you multiply down a column or
across a row, the answer must equal
the product shown.
                            Press RETURN
```

Crossnumber Puzzle problem

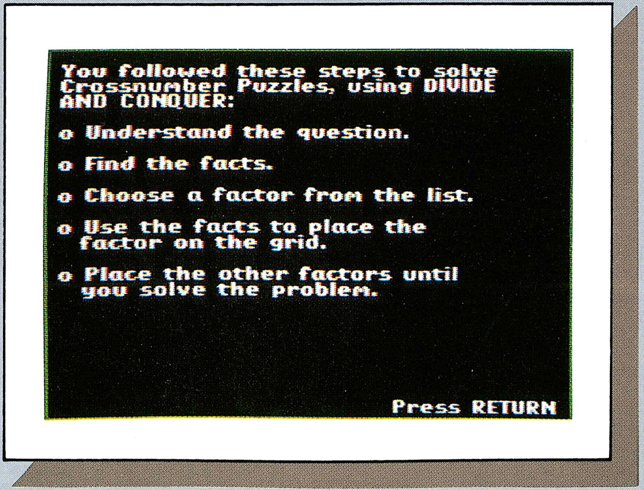
In placing the remaining factors, students work with less guidance than previously but with the option of accessing HELP screens.

The concluding screen of the lesson is a menu that presents these options: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.

Practice

With the selection of option 1 from the lesson's concluding menu, the first screen of the Divide and Conquer practice appears. The practice includes problems identical in rationale to the problem solved in the lesson but having different factors and products. Students may complete a problem independently or may access HELP screens. If they complete the problem correctly, they receive a reward screen and the option of doing another practice problem or returning to the Main Menu. If students complete the problem incorrectly, they may choose to correct the errors themselves or to receive help.

Selection of option 2 at the conclusion of the lesson accesses the Crossnumber Puzzles: Working Backwards lesson. (This lesson is described in the next section.)



```
You followed these steps to solve
Crossnumber Puzzles, using DIVIDE
AND CONQUER:

o Understand the question.

o Find the facts.

o Choose a factor from the list.

o Use the facts to place the
  factor on the grid.

o Place the other factors until
  you solve the problem.



                            Press RETURN
```

Review of divide and conquer steps

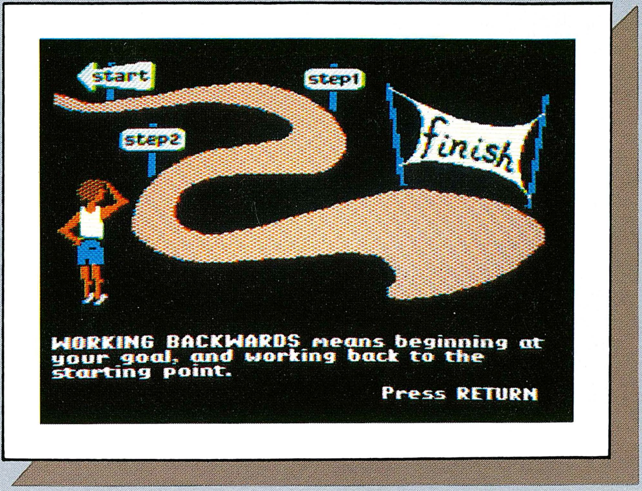
CROSSNUMBER PUZZLES:
Working Backwards

Lesson

In this lesson, students solve the same grid problem as in the Divide and Conquer lesson, but they use a different strategy—that of working backwards. Students first learn that *working backwards* means ‘‘beginning at your goal and working back to the starting point.’’ Next they preview the steps they will follow in using the strategy to solve the problem.

The students are guided in working the problem. First, they select a product, starting with 50 because it is the largest product on the grid. Second, students choose three factors of 50 from the given list, and they enter the factors in a number sentence. The factors of the three products ending the columns—35, 6, 30—are then found and entered in individual number sentences, using the same method.

Students then consider the three products that have 5 as a factor (50, 35, and 30), and are guided in placing the two 5’s on the grid. With the 5’s in place, the row ending with 50 has only one empty cell remaining. Students enter the number 2 in this cell, since it is a factor of both the product 50 and the product 6, which ends the column in which the 2 is placed. Next, the students consider the products 35 and 14 and their factors. They are aided in placing 7 in the cell where the row ending with 14 and the column ending with 35 meet.



WORKING BACKWARDS means beginning at your goal, and working back to the starting point.

Press RETURN

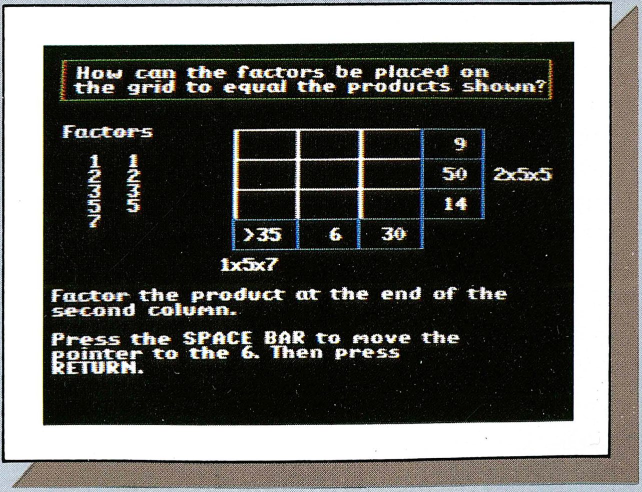
Explanation of working backwards

In placing the remaining factors, students work with less guidance than previously but with the option of accessing HELP screens. The concluding screen of the lesson is a menu that presents these options: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.

Practice

Selection of option 1 from the menu at the conclusion of the lesson, causes the first screen of the Working Backwards practice to appear. The practice includes problems identical in rationale to the problem solved in the lesson but having different factors and products. Students may complete a problem independently or may access HELP screens.

Selection of option 2 at the conclusion of the lesson accesses the Crossnumber Puzzles: Divide and Conquer lesson. (This lesson is described in the preceding section.)



How can the factors be placed on the grid to equal the products shown?

Factor the product at the end of the second column.

Press the SPACE BAR to move the pointer to the 6. Then press RETURN.

Choosing a product to factor

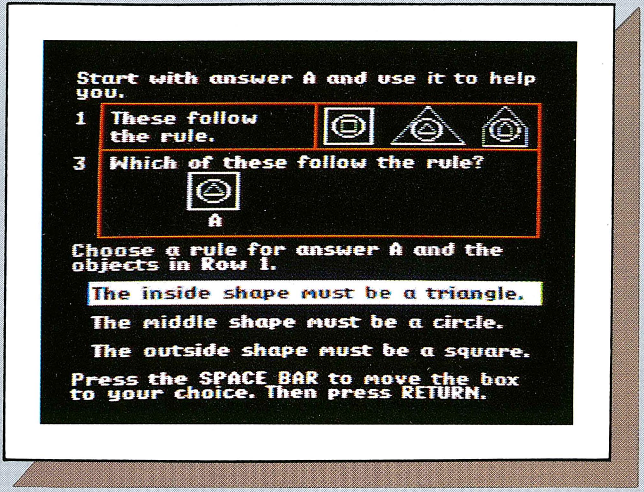
FIND THE RULE: Guess and Test

Lesson

The lesson presents a graphic problem for students to solve, using the strategy of guess and test. Students begin the lesson by analyzing the problem. After the problem has been introduced, the steps to be used in applying the guess and test strategy to solve the problem are listed.

Students begin by guessing that object A in Row 3 is the correct answer. Then they use facts in the problem (the shapes composing the objects) to choose a possible rule that fits both object A and the objects in Row 1.

Next students test the truth of their possible rule by applying the rule to the first object in Row 2, which is composed of objects that do not fit the correct rule. Students determine that the rule fits the first object in Row 2. Since the rule should not apply to any of the objects in Row 2, students learn that they must expand their current possible rule or find a different possible rule.



Start with answer A and use it to help you.

1 These follow the rule.

3 Which of these follow the rule?

A

Choose a rule for answer A and the objects in Row 1.

The inside shape must be a triangle.

The middle shape must be a circle.

The outside shape must be a square.

Press the SPACE BAR to move the box to your choice. Then press RETURN.

Choosing a possible rule

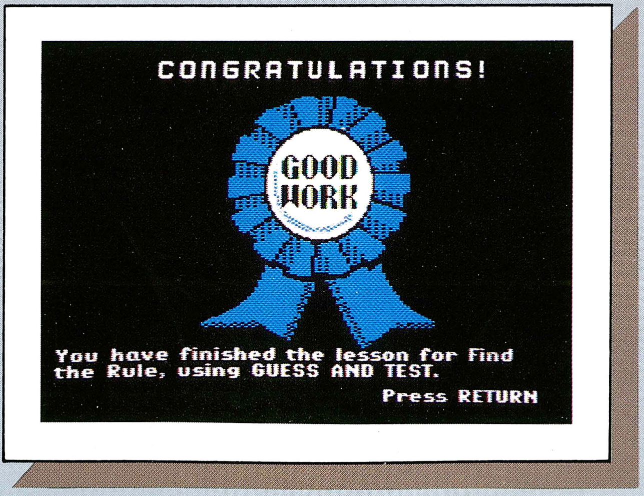
Students then proceed to the fourth step in applying the problem-solving strategy. They guess, or choose, another answer from Row C (object B, C, or D) for which their current possible rule is true, and then they expand the possible rule to include a new fact that fits the new object. Students are guided in discovering that either object B or D fits their original possible rule but that object C does not. By comparing object B or D with objects in Row 2 and Row 1, students are also guided in the discovery that their rule must be expanded. Finally students apply the correct rule to each object in Row 3 to solve the problem.

At the conclusion of the lesson, students receive a reward screen and then a menu screen that presents these options: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.

Practice

With the selection of option 1 from the lesson's concluding menu, the first screen of the Guess and Test practice appears. This practice includes problems identical in rationale to the problem solved in the lesson but having dissimilar facts (objects). Students follow the procedure they learned in the lesson. Students may access HELP screens that review the question and facts in the problem and list the steps in applying the guess and test strategy. Students may find taking notes helpful as they test possible rules.

Students who select option 2 at the conclusion of the lesson access the Find the Rule: Logical Thinking lesson. (This lesson is described in the next section.)



CONGRATULATIONS!

You have finished the lesson for Find the Rule, using GUESS AND TEST.

Press RETURN

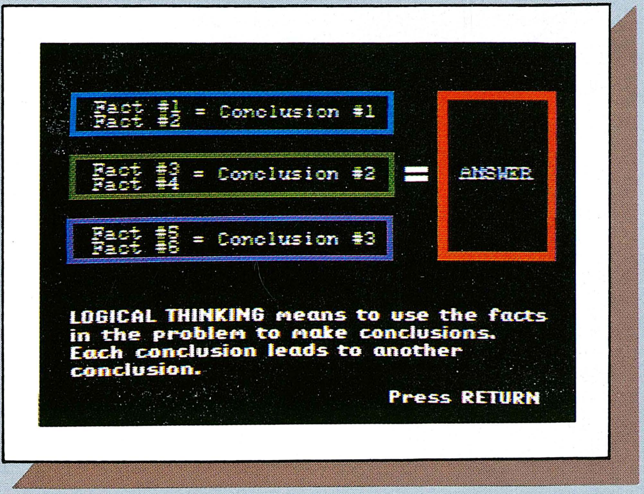
Congratulations

FIND THE RULE: Logical Thinking

Lesson

In this lesson, students solve the same problem as in the Guess and Test lesson, by using a different strategy—that of logical thinking. Students begin by examining the problem. Next, students review the steps they will employ to solve the problem, using the strategy of logical thinking.

Students first determine a possible rule that fits Row 1, which is composed of objects that follow the rule. Selected from among three given answer choices, the possible rule is: "The middle shape must be a circle." Students then apply the possible rule to Row 2, composed of objects that do not follow the rule. They discover that since one of the three objects *does* fit the possible rule, they must find another possible rule or add another part to their existing rule. To find another rule, students reexamine Row 1, and select an additional rule from among three answer choices. The new possible rule is composed of two parts: "The middle shape must be a circle AND the outside and inside shapes must be the same."



LOGICAL THINKING means to use the facts in the problem to make conclusions. Each conclusion leads to another conclusion.

Press RETURN

Explanation of logical thinking

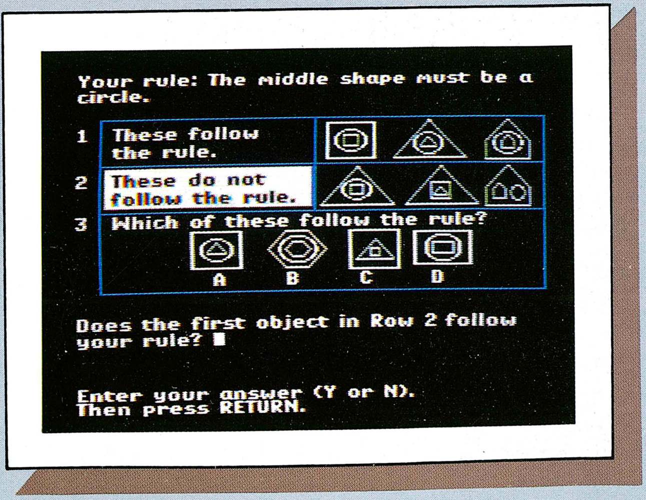
With the new possible rule in mind, students reexamine Row 2, object by object. They determine that since none of the objects follow the possible rule, the possible rule must be the correct rule. Finally students use the correct rule to solve the problem.

At the conclusion of the lesson, students receive a reward screen and then a menu screen that presents these options: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.

Practice

Selection of option 1 from the menu at the conclusion of the lesson, gives students access to the Logical Thinking practice. The practice includes problems identical in rationale to the problem solved in the lesson but having dissimilar facts (objects). Students follow the procedure they learned in the lesson. To aid in the problem-solving process, students may access HELP screens that review the question and facts in the problem, list the steps in applying the logical thinking strategy, and provide hints concerning the rule.

Students who select option 2 at the conclusion of the lesson access the Find the Rule: Guess and Test lesson. (This lesson is described in the preceding section.)



Your rule: The middle shape must be a circle.

1 These follow the rule.

2 These do not follow the rule.

3 Which of these follow the rule?

Does the first object in Row 2 follow your rule? ■

Enter your answer (Y or N).
Then press RETURN.

Checking objects in Row 2 with the rule

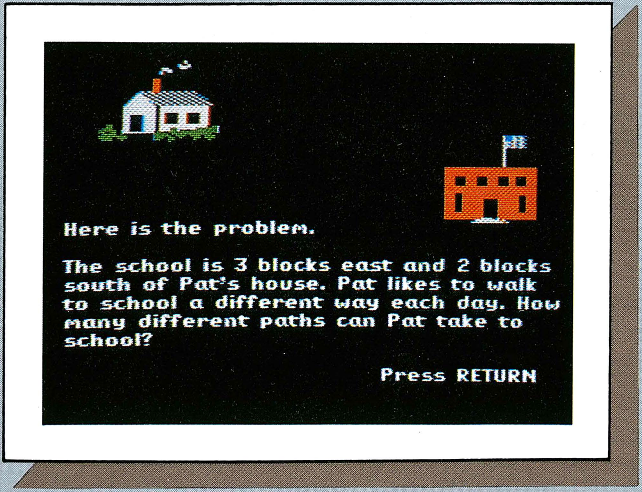
PATHS: Simulation

Lesson

In the lesson, students use the strategy of simulation to solve a problem. The lesson begins by defining a mathematical simulation. Students learn that symbols, graphs, numbers, and drawings may be used to mathematically depict, or simulate, real-life problems. Next, the steps that students will use in solving the problem are presented.

The simulation used by students is a drawing that depicts the blocks, represented by squares, between Pat's house and the school. Students are told that there is an organized way to trace all the possible paths between the house and school. Since the computer has the capability to keep track of each path traced, all the individual paths are not shown. A pair of footprints walks the course of each path as it is being traced by the student. A counter box records each path traced.

Students who successfully trace all paths receive a reward screen. Students who enter an incorrect number of paths are presented with two options: (1) continue tracing the remaining paths independently, or (2) see the paths traced in an organized way. If the latter option is selected, students are told an organized way to trace the paths and may choose to receive a demonstration of how to trace the paths in order, beginning with the paths that start in the eastern direction and ending with the paths that start in a southern direction.



```
Here is the problem.

The school is 3 blocks east and 2 blocks
south of Pat's house. Pat likes to walk
to school a different way each day. How
many different paths can Pat take to
school?

                         Press RETURN
```

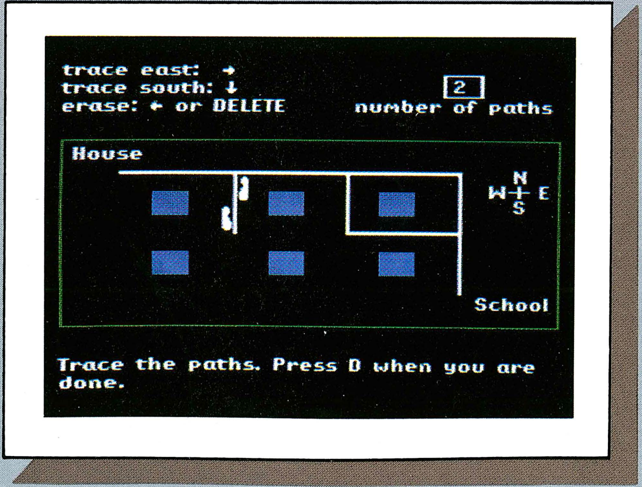
Paths problem

Following the demonstration, students may choose to (1) continue trying to trace the remaining paths independently, (2) erase the paths they have completed and start over again, or (3) see the paths traced in an organized way.

The menu at the conclusion of the lesson presents these options to students: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.

Practice

The problem in this practice is identical in rationale to that solved in the lesson, but the facts are different. Students again trace all possible paths between two sites, using a drawing to simulate the problem. Assumptions underlying the practice are that students understand the concept of a mathematical simulation and that they can apply the steps used to solve a problem, using simulation—knowledge gained through successful completion of the Paths: Simulation lesson. Students may solve the practice problem independently, or they may access HELP screens for aid in solving the problem.



```
trace east: →
trace south: ↓                    2
erase: ← or DELETE      number of paths
```

```
Trace the paths. Press D when you are
done.
```

Tracing the paths

PATHS: Solve a Simpler Problem

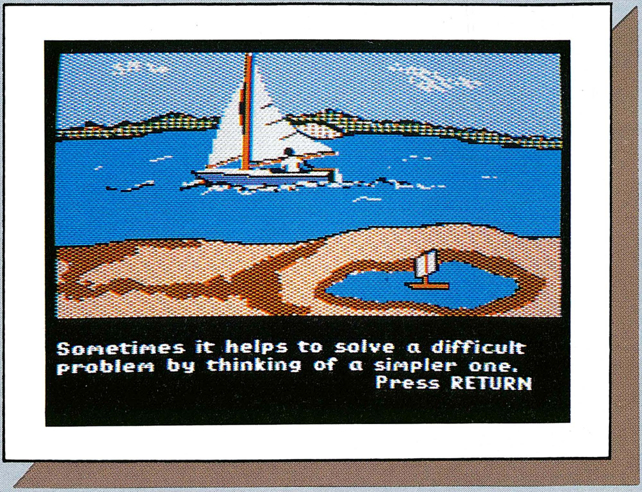
Lesson

Students use the strategy of simplification in this lesson. The problem presented is similar to those in the Paths: Simulation lesson and practice.

Students learn the concept that a difficult problem may be solved by beginning with a similar but simpler problem. Then the steps used in applying the strategy to the problem are presented.

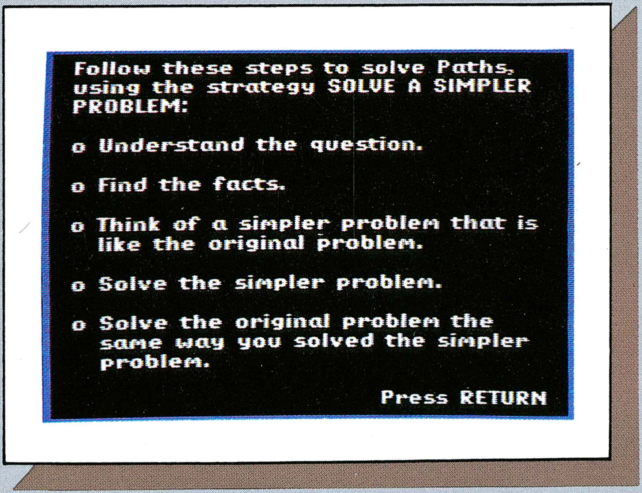
Students begin with one square block between the house and school. They determine that Pat can approach the school by walking to the corner east of the house or the corner south of the house. Each corner is marked with a number 1 to indicate that each represents one different path to the corner. The students are then shown that the sum of the numbers at each corner is 2, and the school is marked with a 2 to indicate that the two paths go to the school. Students continue to use this addition method to determine the number of different paths as the drawing is expanded gradually until it finally includes the 16 square blocks in the original problem.

On completion of the lesson, students receive a reward screen. They then are presented with these options: (1) Go to the practice, (2) Do this problem, using a different strategy, (3) Do the lesson again, (4) Return to the Main Menu.



Sometimes it helps to solve a difficult problem by thinking of a simpler one.
Press RETURN

Explanation of solve a simpler problem



Follow these steps to solve Paths, using the strategy SOLVE A SIMPLER PROBLEM:

- Understand the question.
- Find the facts.
- Think of a simpler problem that is like the original problem.
- Solve the simpler problem.
- Solve the original problem the same way you solved the simpler problem.

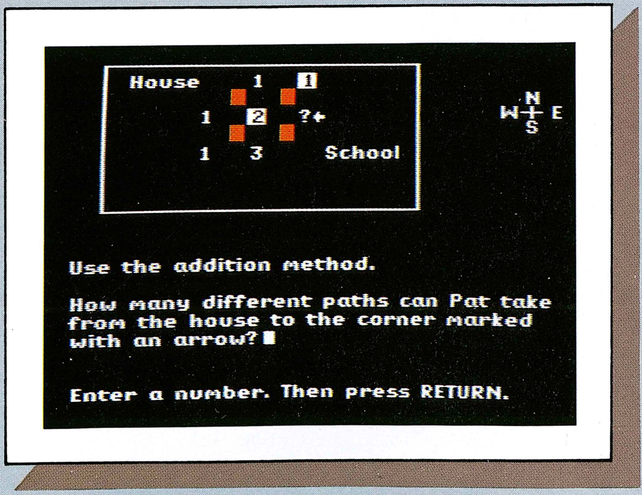
Press RETURN

Solve a simpler problem steps

Practice

Selecting option 1 after completing the lesson lets students choose to solve the original problem or a simpler problem. If they select the former, they use a drawing that simulates the 15 square blocks between two sites. If students select the simpler problem strategy, they choose a small number of blocks to work with initially and eventually move to solving the original problem. HELP screens are available to students throughout the practice.

With the selection of option 2, the first screen of the Paths: Simulation lesson appears. (This lesson is described in the preceding section.)



Use the addition method.

How many different paths can Pat take from the house to the corner marked with an arrow?

Enter a number. Then press RETURN.

Addition method

MICROWORLD DISK

The microworld disk for ***Strategies for Problem Solving II*** includes T-shirt Enterprise and Spirolaterals. T-shirt Enterprise is an economics simulation in which students play the role of the manager of a T-shirt manufacturing company. Students may use any combination of problem-solving strategies to successfully run the company. The strategies used might include Patterns, Divide and Conquer, Guess and Test, Making a List, Logical Thinking, and Simulation. Spirolaterals includes graphics activities in which students are challenged to create designs or to duplicate designs stored on the program disk or a data disk. Students may use any combination of strategies, but they are most likely to use Working Backwards, Divide and Conquer, Patterns, Guess and Test, and Simulation.

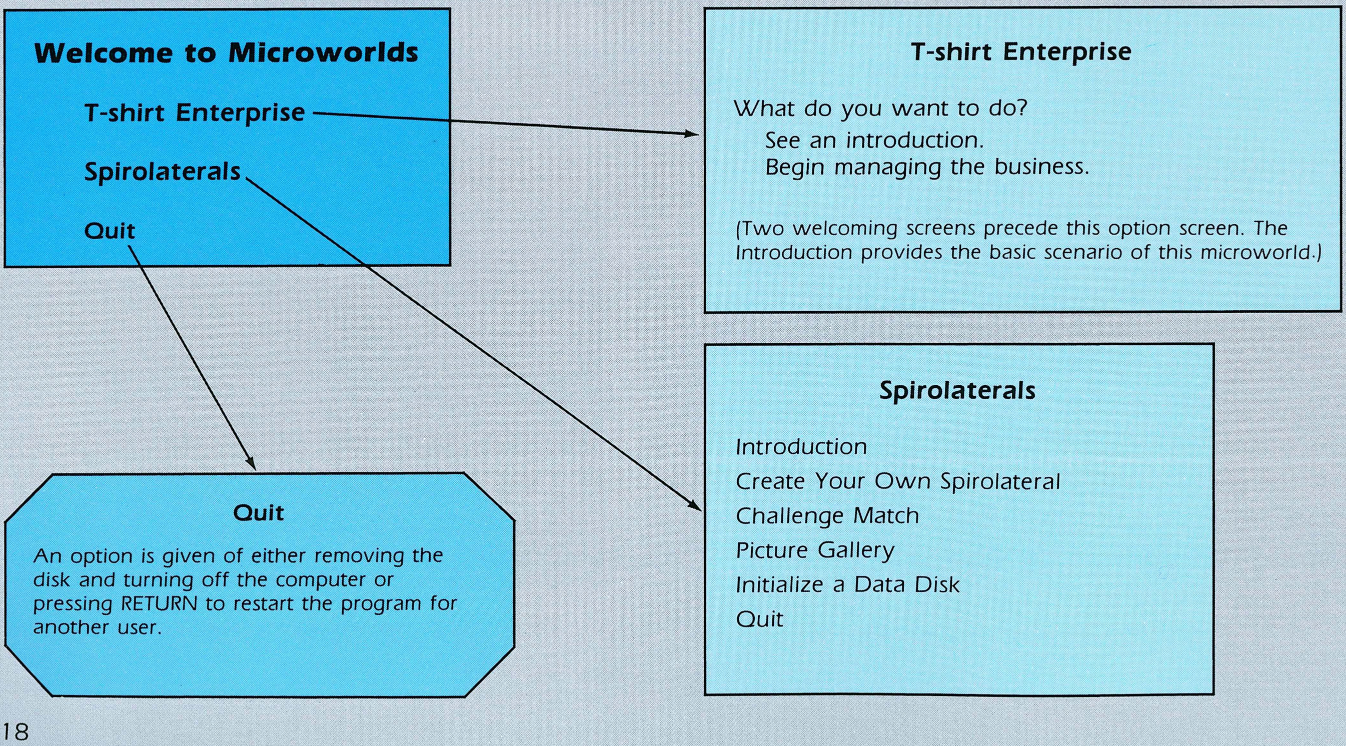
Before working on a microworld, students should be familiar with the strategies and should have completed the lessons and practices. Mastery of all the strategies is not a prerequisite, however. Since the microworlds are designed on the premise that students have different mathematical abilities, they can be used at different levels of experience.

Instructions that students need to work through the microworlds are included in the program, and most students should be able to follow these instructions with little or no assistance. Moreover, students do not need previous keyboarding experience to use the program. A minimal number of keys execute commands in each microworld, and all commands are fully explained within the program text.

The content and rationale of the microworlds are summarized in the sections that follow.

MICROWORLD DISK STRUCTURE

The diagram below shows the general structure of the ***Strategies for Problem Solving II*** program microworld disk by indicating where each selection from the Main Menu leads.



Welcome to Microworlds

T-shirt Enterprise

Spirolaterals

Quit

T-shirt Enterprise

What do you want to do?

See an introduction.

Begin managing the business.

(Two welcoming screens precede this option screen. The Introduction provides the basic scenario of this microworld.)

Spirolaterals

Introduction

Create Your Own Spirolateral

Challenge Match

Picture Gallery

Initialize a Data Disk

Quit

Quit

An option is given of either removing the disk and turning off the computer or pressing RETURN to restart the program for another user.

T-SHIRT ENTERPRISE

This microworld is an interactive economics simulation that reviews and reinforces the problem-solving strategies presented in the lessons. While managing a T-shirt manufacturing company, students develop ten monthly business plans, with achievement of the greatest corporate profit as their ultimate objective. Students are aided in making management decisions by the What-If Machine, a novel forecasting device that allows alternative decisions to be tested prior to final implementation. The simulation is designed for use by individual students in independent learning situations, by small groups of students in cooperative learning situations, and by students in a classroom demonstration setting.

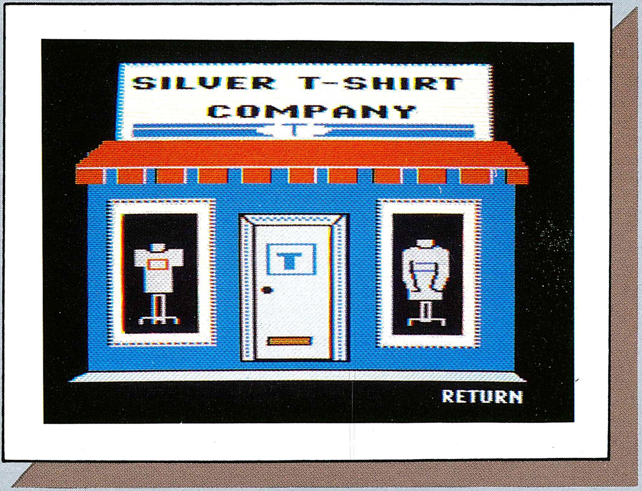
The Scenario

Students employ the capabilities of the What-If Machine and apply problem-solving strategies to achieve this objective: to make the greatest possible profit for the Silver T-shirt Company by choosing (1) the best product design, manufacturing, and advertising plans, (2) the most competitive price for the T-shirts, and (3) the best production level.

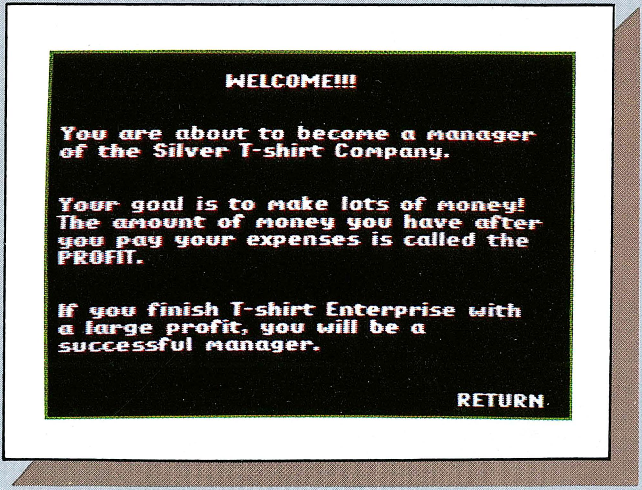
The What-If Machine aids students in predicting the best product price as well as the best production level, for it functions in a manner similar to a real-life business manager's electronic spread sheet.

Students participate in the operations of the company by assuming various managerial roles. There are four major roles: general manager, manager of the manufacturing department, manager of the advertising department, and manager of the product design department. A single participant may choose to manage one, two, or three of the departments. Any departments not selected operate on program default values. Participants not only specify which departments they will manage but also the name of the student assuming each title. Again, any departments not selected operate on program default values. All participants—are stockholders in the company. The managers are advised that the value of the stock will increase if they run the company well.

Students start out with $20,000 cash on hand, and are reminded of their objective to make as great a profit as possible while managing the company over the course of ten business cycles, or months.



Silver T-shirt Company



WELCOME!!!

You are about to become a manager of the Silver T-shirt Company.

Your goal is to make lots of money! The amount of money you have after you pay your expenses is called the PROFIT.

If you finish T-shirt Enterprise with a large profit, you will be a successful manager.

RETURN

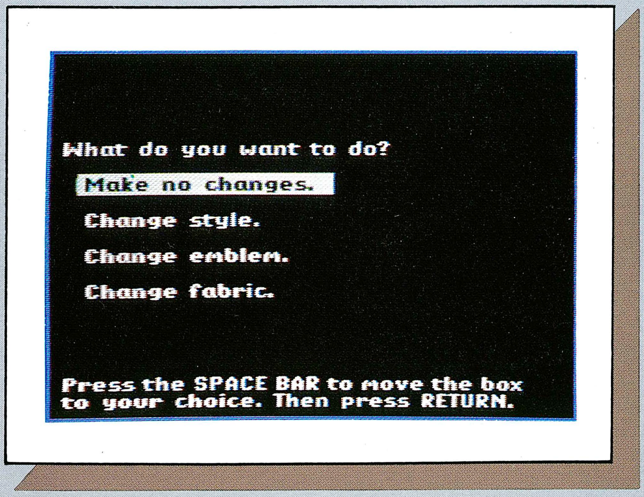
Welcome

Product Design Plan

Product design managers decide whether to create their own T-shirt design plan or to hire a consultant for $2,000. If the self-design option is selected, managers may begin by reading the T-shirt design research report, which presents a series of circle, bar, and broken-line graphs illustrating fabric, emblem, and style trends for a three-year period. Based on information presented in the report, managers design the actual T-shirt by choosing style, emblem, and fabric from among various choices for which low, moderate, and high costs are provided. A graphic of the final design and its associated costs is then presented, and managers may elect to retain or change the design.

If the consultant option is chosen, a graphic of the consultant's T-shirt design is presented, as well as the costs for each T-shirt element: style, emblem, and fabric. In the consultant's plan, the design costs are in the top one fourth of the cost scale 75% of the time and in the bottom one fourth of the scale 25% of the time. After reviewing the consultant's selection and the associated costs, managers may choose to (1) accept the plan, (2) reject the plan and design their own T-shirt, or (3) read the T-shirt design research report before making any decision. The consultant's fee of $2,000 is deducted automatically from the cash on hand, which is displayed in a window on the screen.

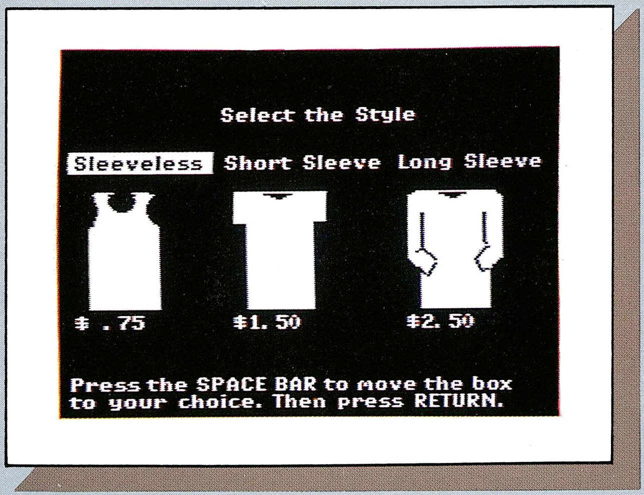
When a participant is not managing the product design department, the default design and its associated costs can be read in the business plan summary. The default design cost is always in the upper one third of the cost scale.



```
What do you want to do?
 Make no changes.
 Change style.
 Change emblem.
 Change fabric.

Press the SPACE BAR to move the box
to your choice. Then press RETURN.
```

Option to change T-shirt design

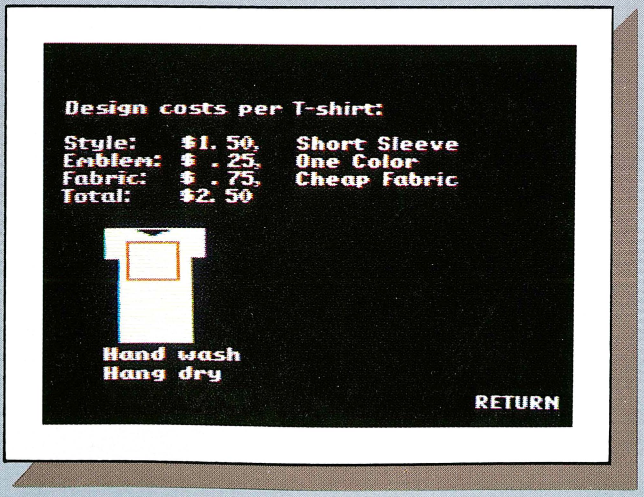


```
            Select the Style
Sleeveless  Short Sleeve  Long Sleeve

$ . 75        $1. 50        $2. 50

Press the SPACE BAR to move the box
to your choice. Then press RETURN.
```

Option to select T-shirt style



```
Design costs per T-shirt:

Style:    $1. 50   Short Sleeve
Emblem:   $ . 25   One Color
Fabric:   $ . 75   Cheap Fabric
Total:    $2. 50

   Hand wash
   Hang dry
                              RETURN
```

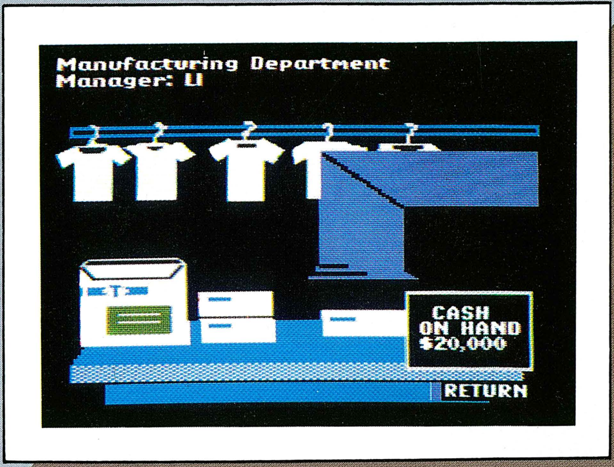
Design costs summary

Manufacturing Department Plan

Manufacturing department managers decide whether to create their own T-shirt manufacturing plan or to hire a consultant for $2,000. If the self-manufacturing option is selected, managers may read a manufacturing research report that presents tabular and textual information regarding manufacturing costs, production levels, and benefits and problems associated with three manufacturing methods: robotics, assembly-line workers, and skilled workers. In creating the actual manufacturing plan, managers use information obtained from the report as well as a table presenting cost per T-shirt, start-up cost, and maximum monthly production level for each method. The completed manufacturing plan includes these categories: manufacturing method selected, maximum production level for method selected, manufacturing cost per T-shirt, and start-up cost. The start-up cost is deducted from the cash on hand only in those cycles in which a new manufacturing method is selected. For example, the start-up cost is always deducted in cycle 1, and it is not deducted again unless a new manufacturing method with a different start-up cost is selected in a subsequent cycle.

If the consultant option is chosen, the consultant's manufacturing plan is presented. The method selected by the consultant consists of skilled workers or assembly line 75% of the time and robotics 25% of the time. After reviewing the consultant's plan and the associated costs, managers may choose to (1) accept the plan, (2) reject the plan and design their own, or (3) read the manufacturing research report before making any decision. The consultant's fee of $2,000 and the start-up cost are deducted from the cash on hand.

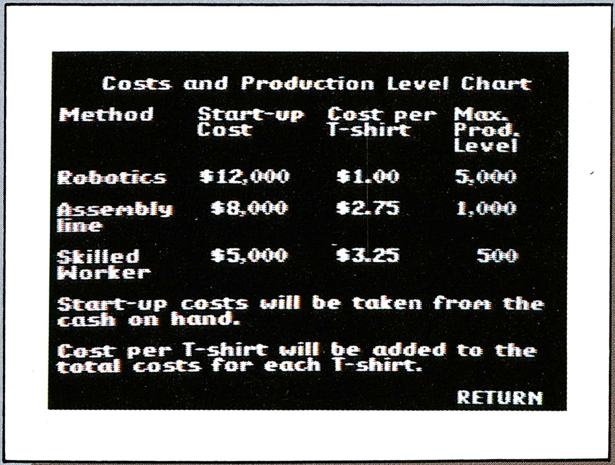
When a participant is not managing the manufacturing department, the default plan and its associated costs are presented in the business plan summary, and the start-up cost is deducted from the cash on hand.



Manufacturing Department
Manager: U

CASH
ON HAND
$20,000

Manufacturing department



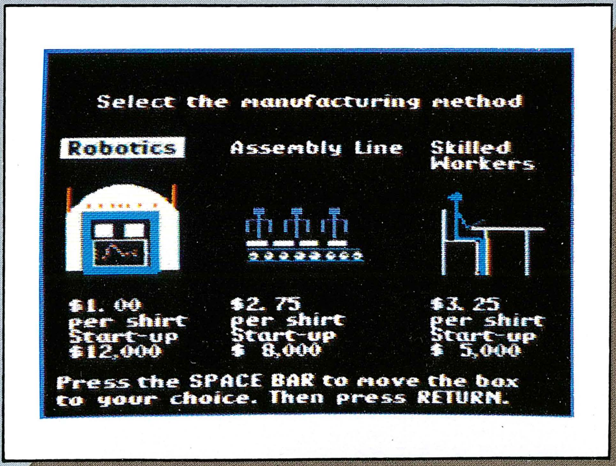
Costs and Production Level Chart

Method	Start-up Cost	Cost per T-shirt	Max. Prod. Level
Robotics	$12,000	$1.00	5,000
Assembly line	$8,000	$2.75	1,000
Skilled Worker	$5,000	$3.25	500

Start-up costs will be taken from the cash on hand.

Cost per T-shirt will be added to the total costs for each T-shirt.

Manufacturing research report chart



Select the manufacturing method

$1.00
per shirt
Start-up
$12,000

$2.75
per shirt
Start-up
$ 8,000

$3.25
per shirt
Start-up
$ 5,000

Press the SPACE BAR to move the box to your choice. Then press RETURN.

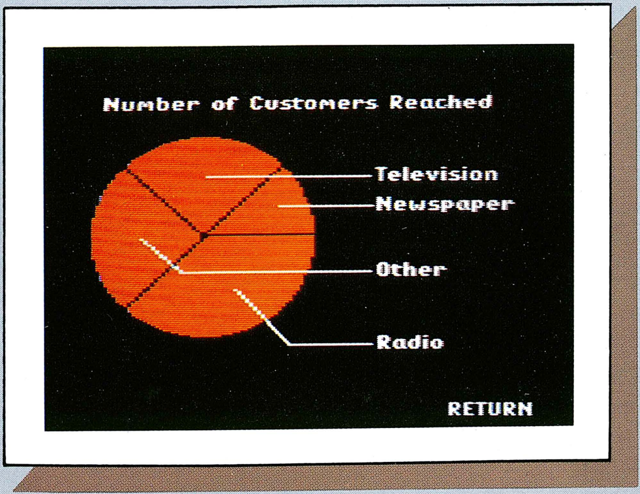
Option to select manufacturing method

Advertising Department Plan

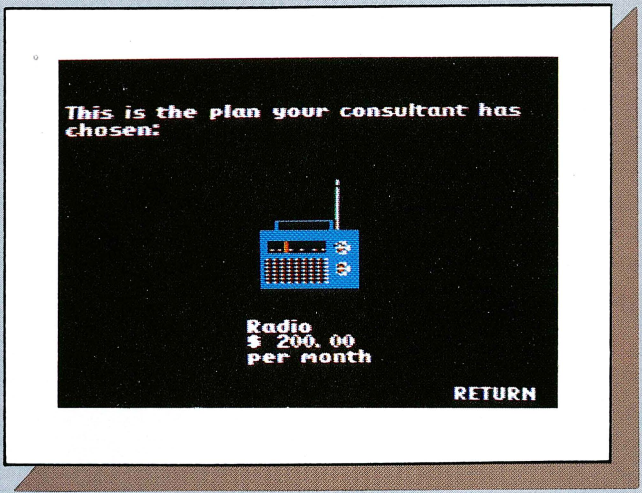
Advertising department managers decide whether to create their own advertising plan or to hire a consultant for $2,000. If the first option is selected, managers may begin by reading the advertising research report. The report presents circle, bar, and broken-line graphs illustrating (1) the number of customers reached by radio, TV, and newspaper, (2) the advertising cost per month reached via the three media, and (3) the total sales attributed to advertising via the three media. To create their advertising plan, managers use information obtained from the report as well as a table listing cost per month of advertising for radio, TV, and newspapers. The completed plan presents the advertising cost per month, based on the medium selected.

If the consultant option is chosen, the consultant's advertising plan is presented. The method of advertising selected by the consultant is TV or radio 75% of the time and newspaper 25% of the time. After reviewing the cost of the consultant's plan, managers may choose to (1) accept the plan, (2) reject the plan and create their own, or (3) read the advertising research report before making any decision. The consultant's fee of $2,000 is deducted from the cash on hand. If the consultant's plan is rejected, managers create a plan following the procedures described previously. If reading the research report is specified, managers study the report before deciding whether to accept or reject the consultant's plan.

When a participant is not managing the advertising department, the default plan and its associated costs are presented in the business plan summary. The advertising method selected by default is in the upper 25% of the cost scale.

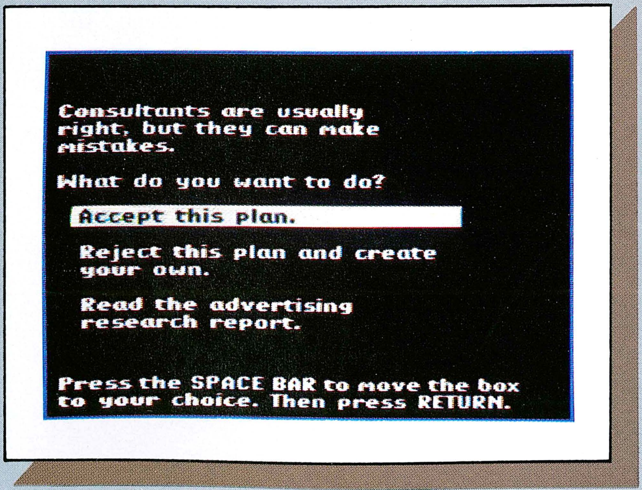


Advertising research report graph


This is the plan your consultant has chosen:

Radio
$ 200.00
per month

Consultant's advertising plan


Consultants are usually right, but they can make mistakes.

What do you want to do?

Accept this plan.

Reject this plan and create your own.

Read the advertising research report.

Press the SPACE BAR to move the box to your choice. Then press RETURN.

Option to accept or reject consultant's plan

Production Level and Selling Price

When the three department plans are complete, participants view a summary of the plans. Next, the general manager uses the What-If Machine to set the production level and selling price.

The What-If monitor displays an equation for determining the profit: Selling Price − Cost Per T-shirt = Profit Per T-shirt. The general manager enters the missing amount for the selling price per T-shirt. The What-If Machine automatically subtracts the cost per T-shirt from the selling price per T-shirt to calculate the profit per T-shirt.

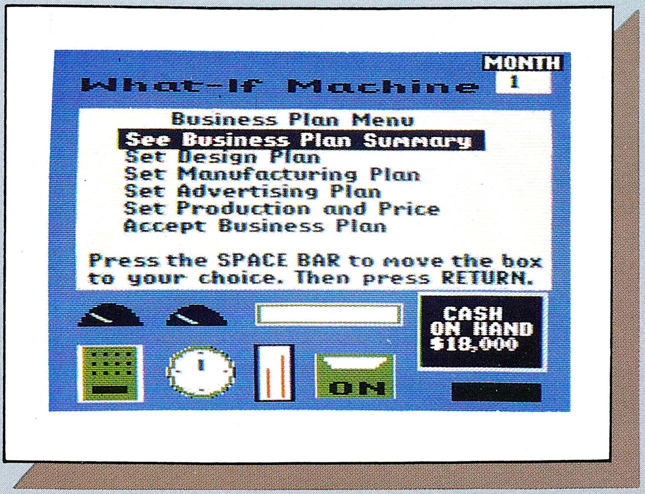
Next, an equation for predicting the total monthly inventory is displayed on the monitor of the What-If Machine: Production Level + Existing Inventory = Inventory.
The general manager enters the missing addend for monthly production level, a figure that should not exceed the maximum monthly production level for the manufacturing method selected. The amount of T-shirts in inventory each month may not exceed 6,000.

The What-If monitor next displays four equations:

Cost Per T-shirt × Production Level = Total T-shirt Costs
Total T-shirt Cost + Start-up Costs + Advertising Costs = Total Expenses
Selling Price × Inventory = Predicted Income
Predicted Income − Total Expenses = Predicted Profit

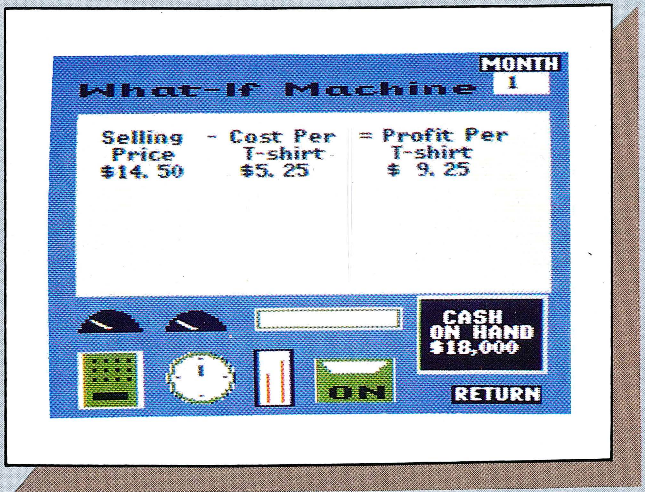
The general manager may elect to change the selling price per T-shirt or one or more department costs not represented by default values in an effort to increase the profit. When the new amounts are inserted in the equation, the What-If Machine recalculates the new profit.

If the predicted profit is unsatisfactory, the general manager may again access the department plan screens to change any costs not obtained by default.


MONTH
1
What-If Machine
Business Plan Menu
See Business Plan Summary
Set Design Plan
Set Manufacturing Plan
Set Advertising Plan
Set Production and Price
Accept Business Plan
CASH ON HAND $18,000
ON

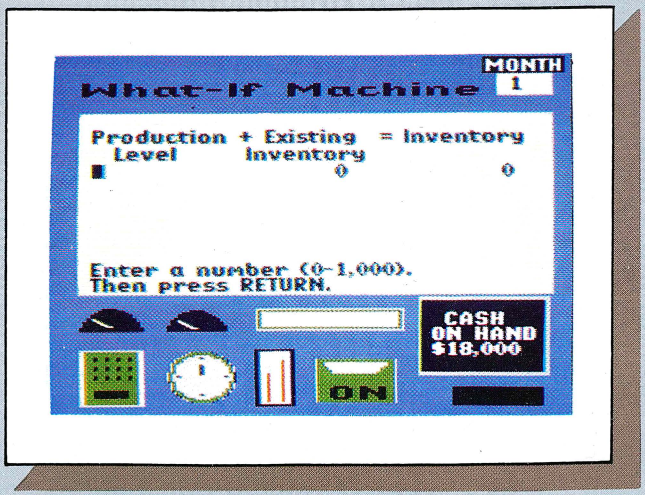
Press the SPACE BAR to move the box to your choice. Then press RETURN.

Business plan menu


MONTH
1
What-If Machine
CASH ON HAND $18,000
ON
RETURN

Selling Price $14.50 − Cost Per T-shirt $5.25 = Profit Per T-shirt $ 9.25

Equation for determining profit


MONTH
1
What-If Machine
CASH ON HAND $18,000
ON

Production Level + Existing Inventory 0 = Inventory 0

Enter a number (0-1,000).
Then press RETURN.

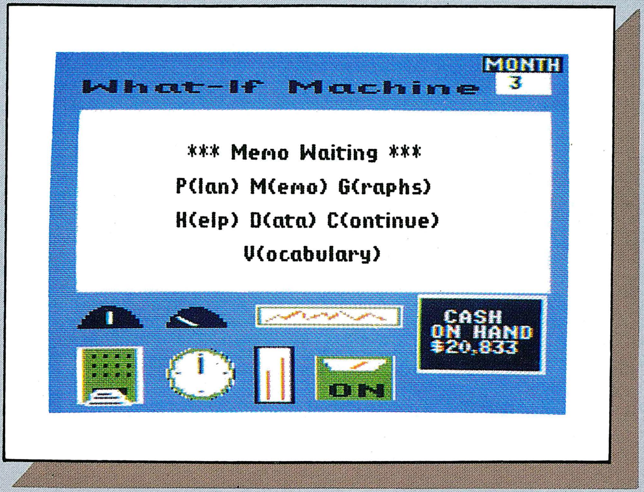
Equation for determining inventory

Random Events

During the course of monthly business cycles 2 through 10, the What-If Machine transmits memos from the department managers to the general manager. The memos concern random events affecting the monthly sales data for a business cycle. A graphic of the What-If Machine control panel appears, with the words **Memo waiting** flashing. A memo may concern a controllable random event or an immediate random event.

Controllable random events are predictable; they affect the sales data for subsequent business cycles but not for the cycle in which they are presented.

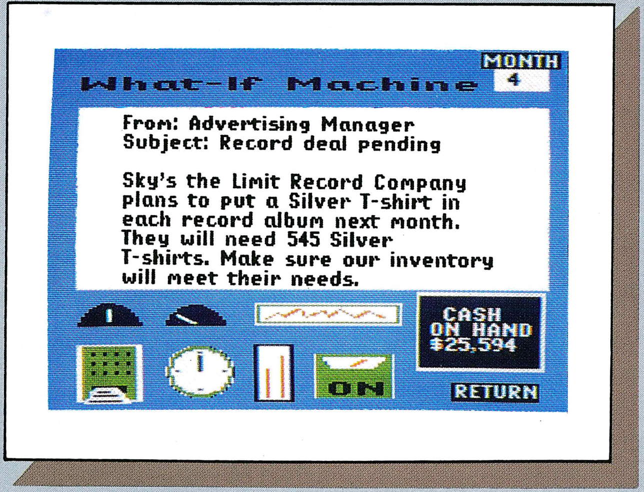
Immediate random events are unpredictable; they affect the sales data for the current business cycle.



Memo light

Teacher Option

The purpose of the random event feature is to accelerate the level of the problem-solving experience for participants in the simulation. If the participants have not mastered the problem-solving strategies, however, the teacher may choose to omit the occurrence of random events. To do this, the teacher presses CONTROL-T while the first menu is displayed. A statement concerning the occurrence of random events appears, and the teacher presses the SPACE BAR to highlight the response choice and then presses RETURN.



From: Advertising Manager
Subject: Record deal pending

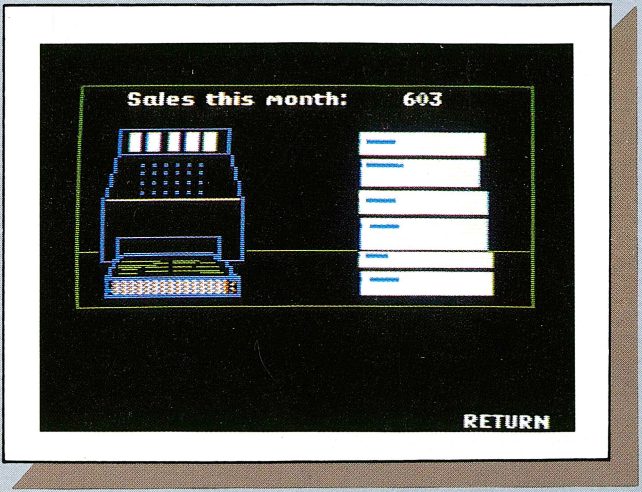
Sky's the Limit Record Company plans to put a Silver T-shirt in each record album next month. They will need 545 Silver T-shirts. Make sure our inventory will meet their needs.

Random event memo

Monthly Business Cycle

When the monthly business plan is complete, that month's business cycle is reproduced graphically and textually. The general manager can press the D key to obtain the T-shirt production and sales data from the What-If Machine. Bar and broken-line graph representations of these data may also be viewed by pressing the G key to access the What-If Machine graph screen.

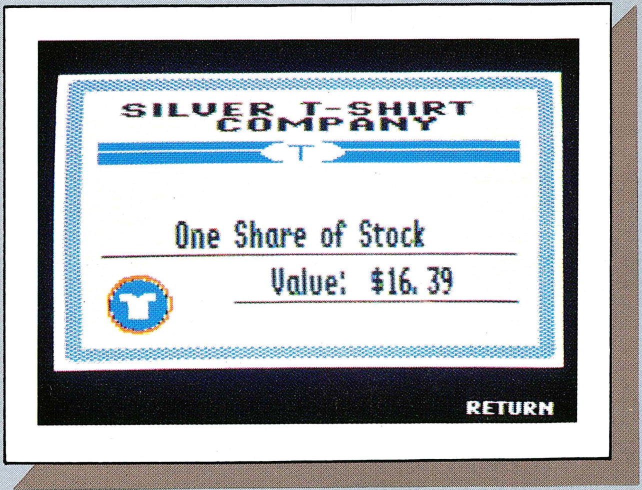
After participants review any monthly sales data for completed cycles numbered 1 through 9, the general manager presses C to access the next cycle. The cash-on-hand window reflects the addition of the previous month's profit.


Sales this month: 603

Monthly sales

Conclusion of Simulation

When business plans for the ten monthly cycles are complete, participants receive a screen that presents the total corporate profit and the new value of the stock. Participants are then given an opportunity to use the What-If Machine to review data or graphs, run T-shirt Enterprise again, or quit. If the participants choose to review the data or graphs, the What-If Machine control panel is displayed. The participants may then press D to review data, G to review graphs, or C to return to the option screen where they may again choose to review the data or graphs, run T-shirt Enterprise again, or quit.


SILVER T-SHIRT COMPANY

One Share of Stock

Value: $16.39

Stock certificate

SPIROLATERALS

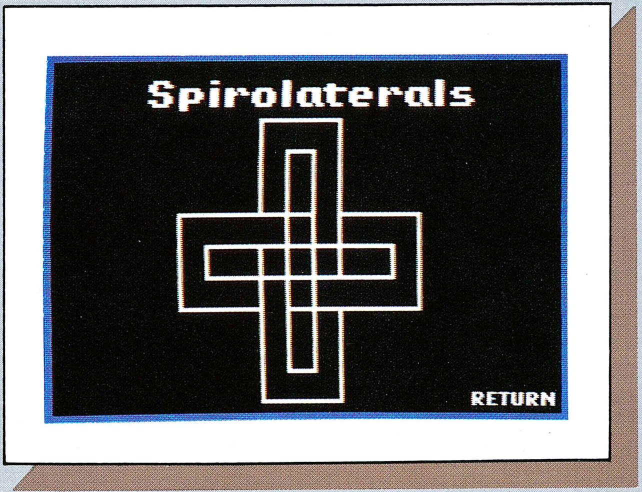
This microworld has three different activities, all of which involve computer graphics: (1) Create Your Own Spirolaterals, (2) Challenge Match, and (3) Picture Gallery. The first two activities review and reinforce the eight problem-solving strategies presented in the lessons.

From the Main Menu for Spirolaterals, students can access an introduction to the microworld, each of the three activities, and instructions for initializing a data disk. A data disk is used to save student spirolaterals designed in the Create Your Own Spirolaterals activity, and should be prepared before students begin the activity. Spirolaterals stored on the data disk are used in the Challenge Match activity (Data-Disk Challenge Match) and in the Picture Gallery activity.

Initializing a Data Disk

If students wish to save the spirolaterals they create, they will need to initialize a blank disk at the start of the program. Disks may be initialized by choosing Initialize a Data Disk from the Spirolaterals Main Menu. This option will bring them to the Initialize a Data Disk screen. If students are using one drive, they should type a 1 and then press RETURN. If students are using 2 drives, they should type a 2 and then press RETURN. (The disk controller card must be in slot # 6.)

RETURN will display instructions to place the blank disk students want to initialize in Drive 1 (or the drive designated on the previous screen). RETURN is pressed to start the initializing process. If students decide not to initialize a disk at this time, ESC can be pressed to quit and go back to the Spirolaterals Main Menu.



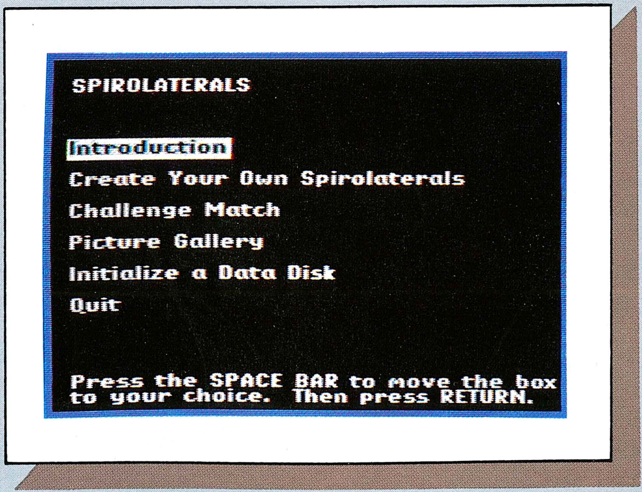
Spirolaterals opening screen

Create Your Own Spirolateral

In this activity, students create designs, called spirolaterals, on a graphics screen. Students also may edit the spirolaterals, color them (if using a color monitor), and save them on an initialized data disk. The drawing device is an arrow that draws lines in units of length and makes turns in degrees, based on input numbers.

INPUT FIELDS

Students enter input numbers into three fields that appear at the bottom of the graphics screen: SIDES, ANGLE, and REPEATS. In the SIDES field, each input number represents the length in units of each side. Up to one line of input numbers may be entered in the SIDES field. A space must be entered between each input number.



```
SPIROLATERALS

Introduction
Create Your Own Spirolaterals
Challenge Match
Picture Gallery
Initialize a Data Disk
Quit


Press the SPACE BAR to move the box
to your choice.  Then press RETURN.
```

Spirolaterals menu

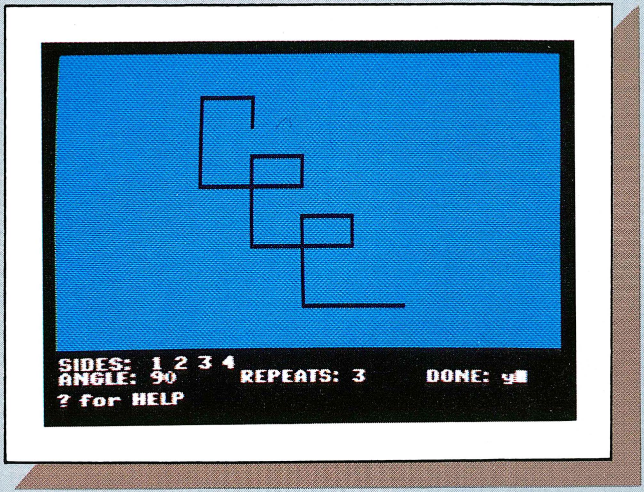
In the ANGLE field a positive input number represents the degrees the arrow revolves counterclockwise between sides of the spirolateral. Only one input number can be entered in the ANGLE field.

In the REPEATS field, the input number represents how many times the specified sides and angle should be drawn.

A cursor designates entry of input numbers, field by field. The cursor always begins in the SIDES field. Students enter an input number or numbers and press RETURN. The cursor then moves to the next field. The cursor does not move to the next field unless an input number has been entered in the previous field and RETURN has been pressed. To erase entries within a field, students use the left arrow key. (The DELETE key also erases entries on the Apple //e and //c.)

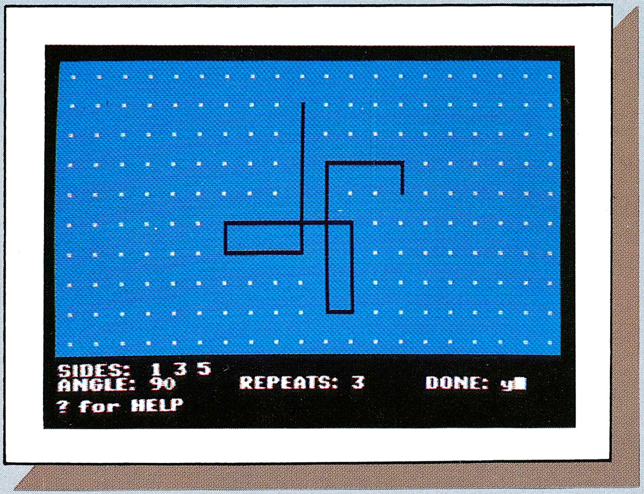
HELP

Students needing assistance while creating a spirolateral can access a HELP screen by pressing the ? key. The HELP screen menu offers five options. If option 1 is selected, the program draws a model spirolateral and displays the field input for that spirolateral. Instructions are given on how to enter data in each field. The choice of option 2 accesses a screen displaying the field input data for the last five spirolaterals that students have created in the current session. Selection of option 3 gives students access to a grid screen composed of dots that correspond to the units of length for side measures. The grid is superimposed over the spirolateral being created, thus enabling students to determine side lengths. The grid stays on until it is turned off by the selection of option 4 from the HELP menu. The choice of option 5, DONE, returns the original program graphics screen.



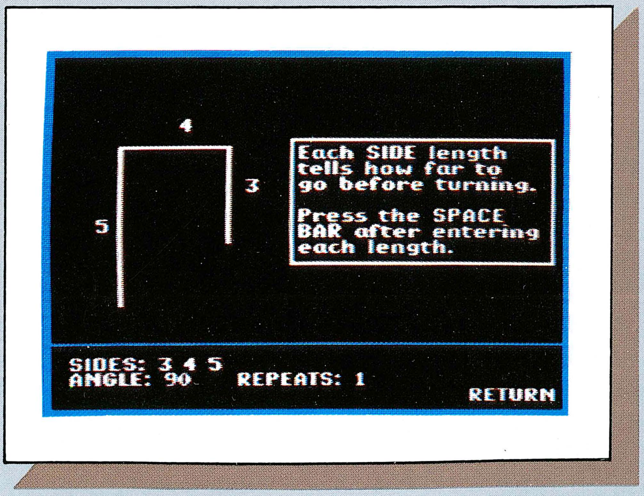
```
SIDES: 1 2 3 4
ANGLE: 90      REPEATS: 3      DONE: y
? for HELP
```

Create Your Own Spirolateral



```
SIDES: 1 3 5
ANGLE: 90      REPEATS: 3      DONE: y
? for HELP
```

Grid turned on



```
Each SIDE length
tells how far to
go before turning.

Press the SPACE
BAR after entering
each length.
```

```
SIDES: 3 4 5
ANGLE: 90   REPEATS: 1
                          RETURN
```

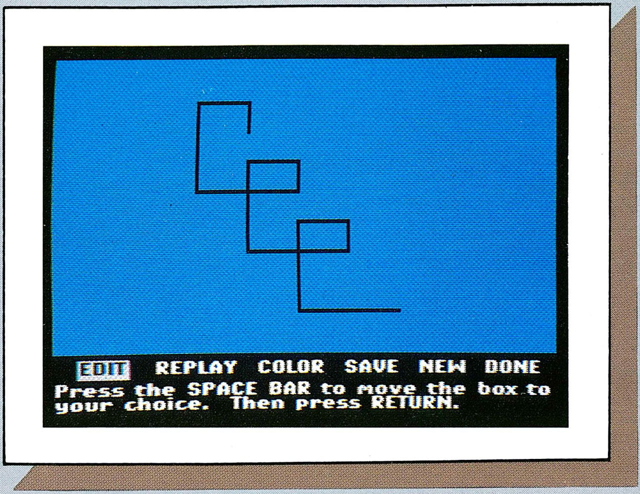
HELP for side length

DRAWING A SPIROLATERAL

In drawing a spirolateral, the arrow always starts in the center of the screen, pointing up. If the spirolateral specified is too large to fit on the screen, a message appears stating this. Students may then edit entries in the numerical input fields to correct the size of the spirolateral.

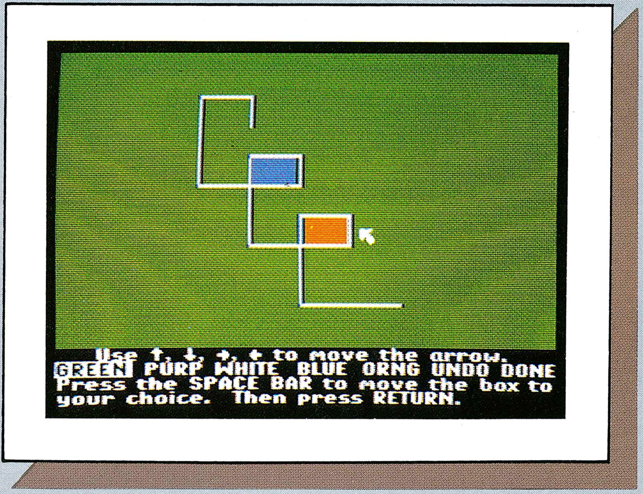
While the spirolateral is being drawn, students can press the SPACE BAR to stop or restart the drawing. This allows students to visualize step by step how the numerical values are translated into sides and angles. When the drawing of the spirolateral is complete, a submenu apears at the bottom of the graphics screen. The submenu offers six options: EDIT, REPLAY, COLOR, SAVE, NEW, and DONE. If REPLAY is selected, the spirolateral is drawn again and then the submenu reappears. With the selection of EDIT, the current numerical input fields appear, and the students can change any of the entries and have the spirolateral drawn again.

The COLOR option enables students using color monitors to color in the spirolateral. First, the students use the arrow keys (I, K, M, J on the Apple II and II Plus) to move a cursor to a section of the spirolateral. Next they press the SPACE BAR to highlight one of five color choices and press RETURN. The color selected is drawn inside the section where the cursor is located in the spirolateral. If the cursor is not in a section of the spirolateral, the color extends to the nearest closed boundary lines. Only one color may be specified per section or area of the spirolateral. UNDO erases the last color that was drawn. Students should select DONE when they are finished coloring.



Press the SPACE BAR to move the box to your choice. Then press RETURN.

Create Your Own Spirolateral submenu


Use ↑, ↓, →, ← to move the arrow.

Press the SPACE BAR to move the box to your choice. Then press RETURN.

Color option

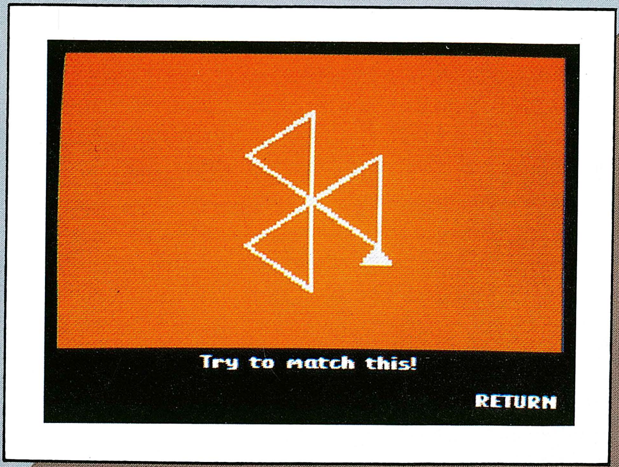
SAVING A SPIROLATERAL

The submenu option of SAVE allows students to save their spirolateral on a data disk that has been initialized using the formatting program accessed from the Main Menu of Spirolaterals. First, the students are instructed to insert the initialized data disk into the drive. Next, the students enter a name of their choice for the spirolateral. The name should not exceed 12 characters in length. It also should be different from the name of any existing spirolateral on the data disk, since a new spirolateral of the same name as an existing one would replace the latter on the disk. If the data disk in the specified disk drive is not valid, this message appears: ''There is no initialized data disk in the drive. The spirolateral was not saved.''

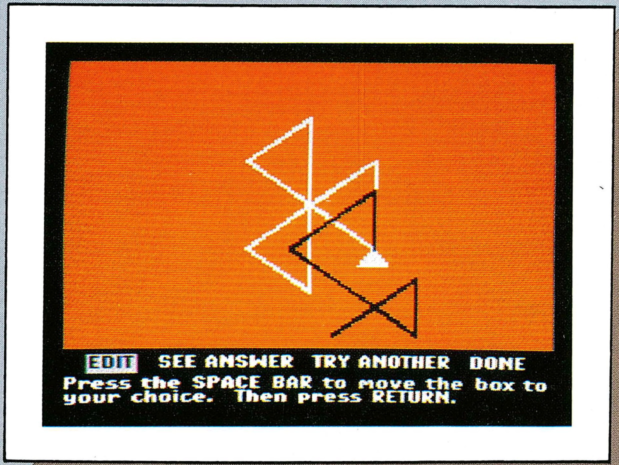
Choice of the submenu option of NEW returns students to a cleared spirolateral graphics screen. Students may begin the process of creating a new spirolateral.

The submenu option of DONE returns students to the Spirolaterals Main Menu.

Challenge Match


Try to match this!

Challenge Match



Press the SPACE BAR to move the box to your choice. Then press RETURN.

Challenge Match submenu

The first screen of this activity presents students with two options: that of matching a spirolateral stored on the program disk or that of matching a spirolateral stored on a data disk.

MATCHING A SPIROLATERAL FROM THE PROGRAM DISK

If the program-disk option is selected, the screen displays three program-disk challenge match levels, with Level 1 being the easiest and Level 3 being the hardest. Students press the SPACE BAR to highlight their level choice and then press RETURN to access a graphics screen. They watch as one of five model spirolaterals stored on the program disk for that level is drawn on the screen. Students attempt to duplicate the measurements of the model spirolateral by entering input numbers into three fields that appear at the bottom of the screen: SIDES, ANGLE, REPEATS.

CHECKING A STUDENT'S MATCH

When the Y response is left in the DONE field and RETURN is pressed, the student spirolateral is drawn over the program-disk spirolateral. The student spirolateral is judged correct only if it has the same lengths and angle in the same sequence as the program-disk spirolateral. If the spirolaterals match, students receive a reward screen and a submenu presenting four options: (1) COLOR, (2) SAVE, (3) TRY ANOTHER, and (4) DONE. The color and save procedures are the same as those used in the Create Your Own Spirolaterals activity.

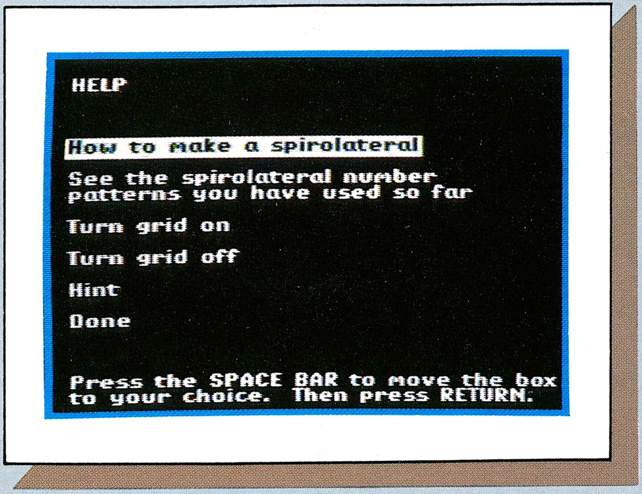
If the student spirolateral does not match the program-disk spirolateral, a submenu presents these options: (1) EDIT, (2) SEE ANSWER, (3) TRY ANOTHER, and (4) DONE. Students selecting option 1 view a screen displaying the spirolateral to be matched and all of their field data, but not the drawing of their incorrect spirolateral. They may then edit the field data in another attempt to match the program-disk spirolateral.

MATCHING A SPIROLATERAL FROM A DATA DISK

If the data-disk option is selected on the first screen of the Challenge Match activity, students are instructed to insert the initialized data disk into the drive (drive 2 or remove the program disk and insert the data disk into the drive if a single-drive system is being used) and to press RETURN. If the data disk is invalid, an error message appears. If the data disk is valid, the catalog of spirolaterals stored on the disk appears on the screen. Students select a spirolateral to match by pressing the SPACE BAR to highlight its name and then pressing RETURN. In the case of a single-drive system, after the spirolateral has been loaded from the data disk, students should remove the data disk and reinsert the program disk. The activity continues in the same manner as when a program-disk spirolateral is used.

HELP

Students needing assistance in duplicating the model spirolateral can access a HELP screen by pressing the ? key. The HELP screen menu offers the same five options as the HELP menu in the Create Your Own Spirolaterals activity (see the preceding section of this guide, ‘‘Create Your Own Spirolaterals Activity’’), and it also offers a HINT option exclusive to the program-disk portion of the activity. Selection of the HINT option accesses a screen displaying hints specific to the particular program-disk spirolateral that students are trying to match.



HELP

How to make a spirolateral

See the spirolateral number patterns you have used so far

Turn grid on

Turn grid off

Hint

Done

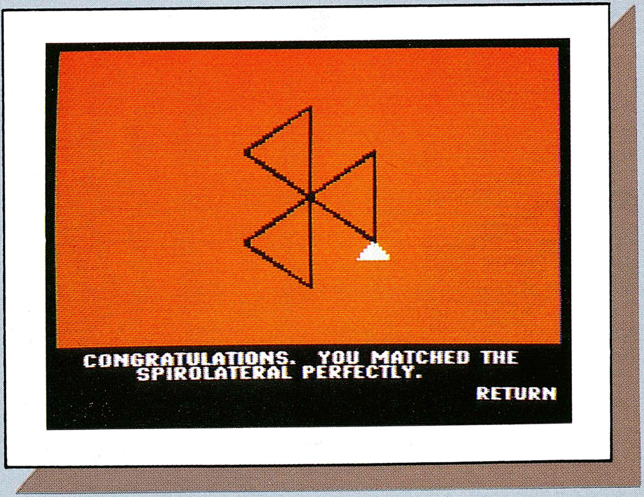
Press the SPACE BAR to move the box to your choice. Then press RETURN.

Challenge Match HELP menu

Picture Gallery Activity

In this activity, students create a picture gallery by selecting among spirolaterals stored on a data disk that has been initialized using the formatting program accessed from the Main Menu of Spirolaterals. First, the students are instructed to insert the data disk into the drive (drive 2 or remove the program disk and insert the data disk into the drive of a single-drive system) and to press RETURN. If the data disk is invalid, an error message appears. If the data disk is valid, the catalog of spirolaterals stored on the disk appears on the screen. Students make each gallery selection by pressing the SPACE BAR to highlight the spirolateral name and then pressing RETURN.

When the selection process is complete, students press the SPACE BAR to highlight DONE, and the spirolaterals are loaded from the data disk. The picture gallery screen appears, and directions in the text area tell students to press the SPACE BAR to start or stop the gallery show at any time. Spirolaterals are drawn one at a time automatically unless the SPACE BAR is pressed to stop the show. After the last spirolateral in the gallery has been drawn, students are given two submenu options: SHOW AGAIN and DONE. If SHOW AGAIN is selected, the gallery of spirolaterals is repeated. If DONE is selected, the Spirolaterals Main Menu returns to the screen.



CONGRATULATIONS. YOU MATCHED THE SPIROLATERAL PERFECTLY.

Challenge Match congratulations

COPY MASTERS

The following pages contain copy masters for use with ***Strategies for Problem Solving II***. Descriptions of the copy masters include suggestions for their use.

Using Patterns to Solve a Problem

This copy master can be used after the Duets: Patterns tutorial and practice. Students record data in tables, and look for patterns in the data. They continue the patterns to solve problems.

Making a List to Solve a Problem

This copy master can be used after the Duets: Making a List tutorial and practice. Students solve the problems by listing data and then deleting duplicate data.

Using Divide and Conquer to Solve a Problem

This copy master can be used after the Crossnumber Puzzles: Divide and Conquer tutorial and practice. Students complete crossnumber puzzles by selecting factors, one by one, to identify the matching products in the puzzle.

Working Backwards to Solve a Problem

This copy master can be used after the Crossnumber Puzzles: Working Backwards tutorial and practice. Students complete crossnumber puzzles by isolating each product in the puzzle and then identifying its factors.

Using Guess and Test or Logical Thinking to Solve a Problem

This copy master can be used after the Find the Rule: Guess and Test or the Find the Rule: Logical Thinking tutorial and practice. Students identify correct rules and choose objects that follow the rules.

Using Simulation and the Addition Method to Solve a Problem

This copy master can be used after the Paths: Solve a Simpler Problem tutorial and practice. Students use drawings and the addition method to solve problems.

T-shirt Enterprise: Department Plan Data Sheet

This copy master is a chart that students can use to record the department plan data for each monthly cycle.

T-shirt Enterprise: Business Plan Data Sheet

This copy master is a chart that students can use to record the business plan data for one monthly cycle. Additional copies of this chart may be made to enable students to record the business plans for all the monthly cycles.

Loading Disks / Keyboard Guide

This copy master may be posted near the computer to provide students with instructions for loading disks and easy reference to special keys used in the program.

Care of Disks

This copy master graphically presents the Do's and Don'ts of disk care and handling. These directions may be reproduced and posted near the computers.

Quick Start

This copy master provides abbreviated and graphic loading instructions for the Apple computer. These directions may be reproduced and posted near the computers as a ready reference for students.

Name ______________________________

Using Patterns to Solve a Problem

1

1. Use patterns to complete the problem below.

A teacher wants to pair up nine students to work on different science experiments. How many different science experiments are possible with nine students working in pairs?

Hint: The pattern in the table has been started for you. You can see that $\boxed{1}$ must be added to 0 to get 1, $\boxed{2}$ must be added to 1 to get 3, and $\boxed{3}$ must be added to 3 to get 6. Continue this pattern to find what number must be added to 6 to get the next number in the table.

Number of Students	Number of Different Experiments by Pairs of Students
1	**0** + $\boxed{1}$
2	**1** + $\boxed{2}$
3	**3** + $\boxed{3}$
4	**6** + ☐
5	+ ☐
6	+ ☐
7	+ ☐
8	+ ☐
9	+ ☐

How many different science experiments are possible with nine students working in pairs? ________

2. Continue the pattern to find how many different science experiments are possible with 17 students working in pairs. ____________

Name ____________________

Making a List to Solve a Problem

2

1. Use making a list to complete the problem below.

Six friends want to pair up to sing duets with one another. Each pair of friends will sing a different duet. How many different duets can the six friends sing?

List the duets in the columns below. Write the first letter of each friend's name in the list. Start by finishing the list in the column under Bruce. If any duets are listed twice, cross out one of them.

Amy	Bruce	Carla	Dale	Evelyn	Frank
A-B	~~B-A~~	~~C-A~~			
A-C	B-C				
A-D	B-D				
A-E					
A-F					

How many different duets can the six friends sing? __________

2. Use making a list to solve the problem below.

Nine members of the chess club are going to pair up and play chess with one another. Each pair will play one game. How many different chess games will be played?

Pam	Hector	Luis	Anita	Bernard	Ian	Camille	Greta	Mai

How many different chess games can the nine members play? __________

Name ______________________________

Using Divide and Conquer to Solve a Problem

3

1. Use divide and conquer to complete the problem below.

FACTORS

1 1
2 2
3 3
5 5
~~6~~

			10
6			18
			30
24	25	9	

The numbers in the list above are factors. The numbers on the grid are products of the factors. How can the factors be placed on the grid so that when multiplied across a row or down a column they equal the products shown?

The largest factor in the list is 6. It is a factor of both 18 and 24 so it has been placed in the row ending with 18 and the column ending with 24.

Place the remaining 8 factors on the grid. Always start with the largest factor remaining in the list.

2. Use divide and conquer to complete the problem below.

Place the factors on the grid so that when multiplied down a column or across a row they equal the products shown.

FACTORS

1 1
2 2
3 3
~~5~~ 5
7

			21
5			20
			15
25	18	14	

Name ______________________________

Working Backwards to Solve a Problem

4

1. Use working backwards to complete the problem below.

FACTORS

1 1
2
3 3
4 4
5 5

			18	___ × ___ × ___
	5		25	1 × 5 × 5
			16	___ × ___ × ___
12	40	15		
___ × ___ × ___	2 × 4 × 5	___ × ___ × ___		

The numbers in the list above are factors. The numbers on the grid are products which contain the factors. How can the factors be placed on the grid so they multiply across or down to equal the products?

The largest product on the grid is 40. The 3 factors from the list that are factors of 40 have been written in a multiplication sentence below the 40. The factors of the product 25 have also been written in a multiplication sentence. Since 5 is a factor of both 40 and 25, it has been placed in the row ending with 25 and the column ending with 40.

Factor the remaining products and place the factors correctly on the grid.

2. Use working backwards to solve the problem below.

FACTORS

1 1
2 2
3 3
5
7 7

			21	___ × ___ × ___
			28	___ × ___ × ___
			15	___ × ___ × ___
49	30	6		
___ × ___ × ___	___ × ___ × ___	___ × ___ × ___		

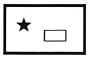
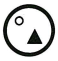
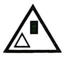
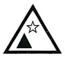
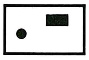
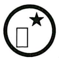
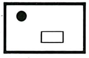
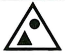
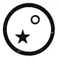
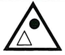
Name ______________________________

Using Guess and Test or Logical Thinking to Solve a Problem

5

Read and solve each problem below.

1.

1	These follow the rule.				
2	These do not follow the rule.				
3	Which of these follow the rule?	 **A**	 **B**	 **C**	 **D**

Write the correct rule.

____

____

Which objects in Row 3 follow the correct rule?

____

2.

1	These follow the rule.	2, 5, 25	1, 4, 20	3, 6, 30	
2	These do not follow the rule.	2, 6, 23	4, 7, 21	5, 9, 18	
3	Which of these follow the rule?	4, 6, 24 **A**	4, 7, 35 **B**	5, 8, 40 **C**	6, 8, 16 **D**

Write the correct rule.

____

____

Which number patterns in Row 3 follow the correct rule?

____

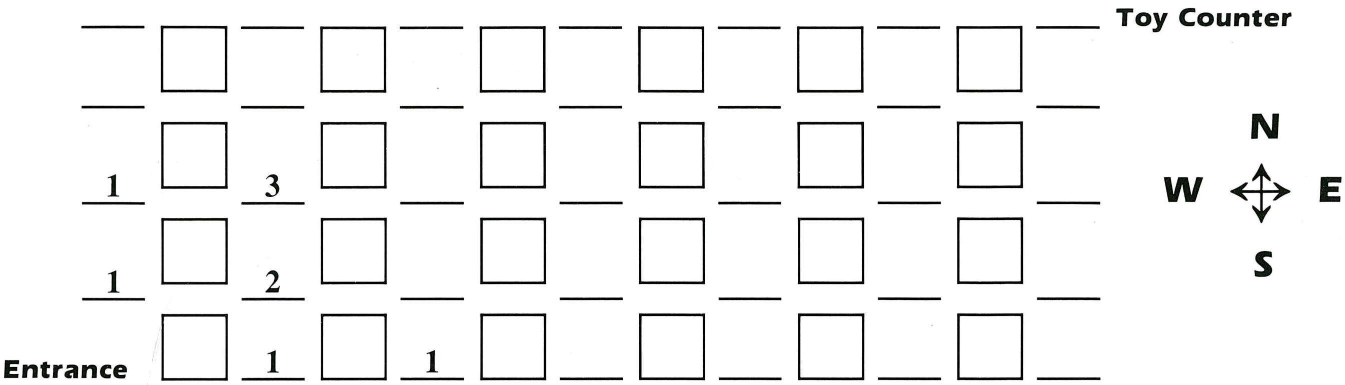
Name ______________________________

Using Simulation and the Addition Method to Solve a Problem 6

1. Use the addition method to solve the problem below.

The toy counter is 4 aisles north and 6 aisles east of the main entrance of the ABC Department store. How many different paths can Chris take from the store entrance to the toy counter?

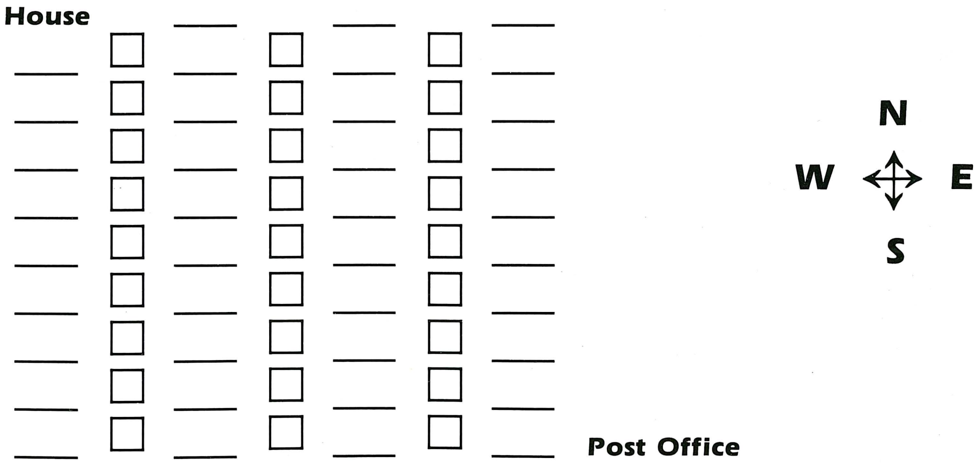
Hint: First fill in the corner numbers for the bottom row of blocks east of the entrance.



What is the total number of different paths that Chris can take from the store entrance to the toy counter? ________

2. Use the addition method to solve the problem below.

The post office is 9 blocks south and 3 blocks east of Mrs. Valdez's house. Mrs. Valdez likes to drive a different route to the post office each day. How many different routes can Mrs. Valdez take from her house to the post office?



How many different routes can Mrs. Valdez take from her house to the post office? __________

Name ______________________________

T-shirt Enterprise: Department Plan Data Sheet

7

Record the department plan data for each monthly cycle on this sheet.

	MONTHLY CYCLE									
	1	2	3	4	5	6	7	8	9	10
Product Design Plan										
Cost per T-shirt										
Consultant's fee										
Manufacturing Plan										
Method selected										
Cost per T-shirt										
Start-up cost										
Maximum production										
Consultant's fee										
Advertising Plan										
Method selected										
Cost per month										
Consultant's fee										

Name ____

T-shirt Enterprise: Business Plan Data Sheet

8

Record the business plan data for each monthly cycle on this sheet.

Cycle ______

Selling Price − Cost Per T-shirt = Profit Per T-shirt

________________ − ____________ = ________________

Production Level + Existing Inventory = Inventory

________________ + ____________ = ________________

Cost Per T-shirt × Production Level = Total T-shirt Costs

________________ × ____________ = ________________

Selling Price × Inventory = Predicted Income

________________ × ____________ = ________________

Predicted Income − Total Expenses = Predicted Profit

________________ − ____________ = ________________

Monthly sales data: Existing Inventory ____________

Total Sales ____________

Total Profit ____________

Cash on Hand ____________

ANSWER KEY

Name ____________________

Using Patterns to Solve a Problem

1

1. Use patterns to complete the problem below.

A teacher wants to pair up nine students to work on different science experiments. How many different science experiments are possible with nine students working in pairs?

Hint: The pattern in the table has been started for you. You can see that $\boxed{1}$ must be added to 0 to get 1, $\boxed{2}$ must be added to 1 to get 3, and $\boxed{3}$ must be added to 3 to get 6. Continue this pattern to find what number must be added to 6 to get the next number in the table.

Number of Students	Number of Different Experiments by Pairs of Students
1	0 + $\boxed{1}$
2	1 + $\boxed{2}$
3	3 + $\boxed{3}$
4	6 + $\boxed{4}$
5	10 + $\boxed{5}$
6	15 + $\boxed{6}$
7	21 + $\boxed{7}$
8	28 + $\boxed{8}$
9	36 + $\boxed{9}$
10	45 + $\boxed{10}$
11	55 + $\boxed{11}$
12	66 + $\boxed{12}$
13	78 + $\boxed{13}$
14	91 + $\boxed{14}$
15	105 + $\boxed{15}$
16	120 + $\boxed{16}$
17	136

How many different science experiments are possible with nine students working in pairs? 36

2. Continue the pattern to find how many different science experiments are possible with 17 students working in pairs. 136

Name ____________________

Making a List to Solve a Problem

2

1. Use making a list to complete the problem below.

Six friends want to pair up to sing duets with one another. Each pair of friends will sing a different duet. How many different duets can the six friends sing?

List the duets in the columns below. Write the first letter of each friend's name in the list. Start by finishing the list in the column under Bruce. If any duets are listed twice, cross out one of them.

Amy	Bruce	Carla	Dale	Evelyn	Frank
A-B	~~B-A~~	~~C-A~~	~~D-A~~	~~E-A~~	~~F-A~~
A-C	B-C	~~C-B~~	~~D-B~~	~~E-B~~	~~F-B~~
A-D	B-D	C-D	~~D-C~~	~~E-C~~	~~F-C~~
A-E	B-E	C-E	D-E	~~E-D~~	~~F-D~~
A-F	B-F	C-F	D-F	E-F	~~F-E~~

How many different duets can the six friends sing? 15

2. Use making a list to solve the problem below.

Nine members of the chess club are going to pair up and play chess with one another. Each pair will play one game. How many different chess games will be played?

Pam	Hector	Luis	Anita	Bernard	Ian	Camille	Greta	Mai
P-H	~~H-P~~	~~L-P~~	~~A-P~~	~~B-P~~	~~I-P~~	~~C-P~~	~~G-P~~	~~M-P~~
P-L	H-L	~~L-H~~	~~A-H~~	~~B-H~~	~~I-H~~	~~C-H~~	~~G-H~~	~~M-H~~
P-A	H-A	L-A	~~A-L~~	~~B-L~~	~~I-L~~	~~C-L~~	~~G-L~~	~~M-L~~
P-B	H-B	L-B	A-B	~~B-A~~	~~I-A~~	~~C-A~~	~~G-A~~	~~M-A~~
P-I	H-I	L-I	A-I	B-I	~~I-B~~	~~C-B~~	~~G-B~~	~~M-B~~
P-C	H-C	L-C	A-C	B-C	I-C	~~C-I~~	~~G-I~~	~~M-I~~
P-G	H-G	L-G	A-G	B-G	I-G	C-G	~~G-C~~	~~M-C~~
P-M	H-M	L-M	A-M	B-M	I-M	C-M	G-M	~~M-G~~

How many different chess games can the nine members play? 36

Name ____________________

Using Divide and Conquer to Solve a Problem

3

1. Use divide and conquer to complete the problem below.

FACTORS

1 1
2 2
3 3
5 5
~~6~~

2	5	1	10
6	1	3	18
2	5	3	30
24	25	9	

The numbers in the list above are factors. The numbers on the grid are products of the factors. How can the factors be placed on the grid so that when multiplied across a row or down a column they equal the products shown?

The largest factor in the list is 6. It is a factor of both 18 and 24 so it has been placed in the row ending with 18 and the column ending with 24.

Place the remaining 8 factors on the grid. Always start with the largest factor remaining in the list.

2. Use divide and conquer to complete the problem below.

Place the factors on the grid so that when multiplied down a column or across a row they equal the products shown.

FACTORS

1 1
2 2
3 3
~~5~~ 5
7

1	3	7	21
5	2	2	20
5	3	1	15
25	18	14	

Name ____________________

Working Backwards to Solve a Problem

4

1. Use working backwards to complete the problem below.

FACTORS

1 1
2
3 3
4 4
~~5~~ 5

3	2	3	18	2 × 3 × 3
1	5	5	25	1 × 5 × 5
4	4	1	16	1 × 4 × 4
12	40	15		
1 × 3 × 4	2 × 4 × 5	1 × 3 × 5		

The numbers in the list above are factors. The numbers on the grid are products which contain the factors. How can the factors be placed on the grid so they multiply across or down to equal the products?

The largest product on the grid is 40. The 3 factors from the list that are factors of 40 have been written in a multiplication sentence below the 40. The factors of the product 25 have also been written in a multiplication sentence. Since 5 is a factor of both 40 and 25, it has been placed in the row ending with 25 and the column ending with 40.

Factor the remaining products and place the factors correctly on the grid.

2. Use working backwards to solve the problem below.

FACTORS

1 1
2 2
3 3
5
7 7

7	3	1	21	1 × 3 × 7
7	2	2	28	2 × 2 × 7
1	5	3	15	1 × 3 × 5
49	30	6		
1 × 7 × 7	2 × 3 × 5	1 × 2 × 3		

ANSWER KEY

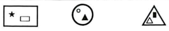
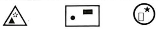
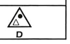
Name ______________________

Using Guess and Test or Logical Thinking to Solve a Problem

5

Read and solve each problem below.

1.

1	These follow the rule.	
2	These do not follow the rule.	
3	Which of these follow the rule?	A B C  D

Write the correct rule.

The inside shape that is like the outside shape is not shaded AND the other inside shape is shaded.

Which objects in Row 3 follow the correct rule?

A, C, D

2.

1	These follow the rule.	2, 5, 25	1, 4, 20	3, 6, 30	
2	These do not follow the rule.	2, 6, 23	4, 7, 21	5, 9, 18	
3	Which of these follow the rule?	4, 6, 24 A	4, 7, 35 B	5, 8, 40 C	6, 8, 16 D

Write the correct rule.

Add 3 to the first number to get the second number and multiply the second number by 5 to get the third number.

Which number patterns in Row 3 follow the correct rule?

B, C

Name ______________________

Using Simulation and the Addition Method to Solve a Problem

6

1. Use the addition method to solve the problem below.

The toy counter is 4 aisles north and 6 aisles east of the main entrance of the ABC Department store. How many different paths can Chris take from the store entrance to the toy counter?

Hint: First fill in the corner numbers for the bottom row of blocks east of the entrance.

	1	5	15	35	70	126	210	**Toy Counter**
	1	4	10	20	35	56	84	
	1	3	6	10	15	21	28	
	1	2	3	4	5	6	7	
Entrance		1	1	1	1	1	1	

N
W **E**
S

What is the total number of different paths that Chris can take from the store entrance to the toy counter? 210

2. Use the addition method to solve the problem below.

The post office is 9 blocks south and 3 blocks east of Mrs. Valdez's house. Mrs. Valdez likes to drive a different route to the post office each day. How many different routes can Mrs. Valdez take from her house to the post office?

House		1	1	1	
	1	2	3	4	
	1	3	6	10	
	1	4	10	20	
	1	5	15	35	
	1	6	21	56	
	1	7	28	84	
	1	8	36	120	
	1	9	45	165	
	1	10	55	220	**Post Office**

N
W **E**
S

How many different routes can Mrs. Valdez take from her house to the post office? 220

Name ______________________

T-shirt Enterprise: Department Plan Data Sheet

7

Record the department plan data for each monthly cycle on this sheet.

	MONTHLY CYCLE 1	2	3	4	5	6	7	8	9	10
Product Design Plan										
Cost per T-shirt										
Consultant's fee										
Manufacturing Plan										
Method selected										
Cost per T-shirt										
Start-up cost										
Maximum production										
Consultant's fee										
Advertising Plan										
Method selected										
Cost per month										
Consultant's fee										

Name ______________________

T-shirt Enterprise: Business Plan Data Sheet

8

Record the business plan data for each monthly cycle on this sheet.

Cycle _____

Selling Price − **Cost Per T-shirt** = **Profit Per T-shirt**

______________ − ______________ = ______________

Production Level + **Existing Inventory** = **Inventory**

______________ + ______________ = ______________

Cost Per T-shirt × **Production Level** = **Total T-shirt Costs**

______________ × ______________ = ______________

Selling Price × **Inventory** = **Predicted Income**

______________ × ______________ = ______________

Predicted Income − **Total Expenses** = **Predicted Profit**

______________ − ______________ = ______________

Monthly sales data: **Existing Inventory** ______________

Total Sales ______________

Total Profit ______________

Cash on Hand ______________

LOADING DISKS / KEYBOARD GUIDE

To load a ***Strategies for Problem Solving II*** disk, first turn on the monitor but not the computer. With your thumb on the label and the label facing up, insert the disk into the disk drive, oval cutout first. Then close the disk drive door, and turn the computer on. The red light will come on, and the disk will whir. In a few seconds the title screens will appear.

If nothing happens, check that the disk is positioned properly (label up). Make sure that the monitor is plugged into the computer and that all other connections are secure. Then repeat the loading instructions.

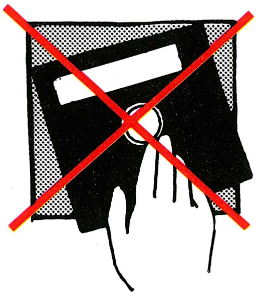
Follow directions on the screen when the reverse side of a disk is required.

KEYBOARD GUIDE
STRATEGIES FOR PROBLEM SOLVING II

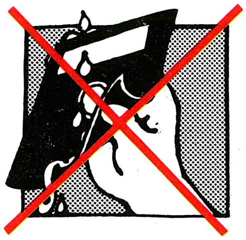
USE	TO
RETURN	Advance screen, or lock an entry into place
DELETE	Erase an entry (used before pressing RETURN to lock entry into place) on Apple® //e and Apple® //c
←	Erase an entry (used before pressing RETURN to lock entry into place) on Apple® II Plus
ESC	Stop what you are doing and return to Main Menu or a previous screen
SPACE BAR	Move highlight bar to your choice; start or stop drawing a spirolateral
Number Keys (0–9)	Enter digits in problems
C	Continue: start the month's production and sale of T-shirts
D	Data: see the monthly production and sales data for T-shirts
	Done: indicate when you have finished an activity, where appropriate
G	Graph: see graphs of inventory, profit, sales, production level of T-shirts
H	Help: get HELP
M	Memo: read memos that are waiting (*T-shirt Enterprise*)
P	Plan: change your business plan (*T-shirt Enterprise*)
	Problem: see the problem on the Lesson Disk
T	Trace: see paths traced (*Paths*: Simulation)
V	Vocabulary: see business terms defined (*T-shirt Enterprise*)
Y	Answer "yes," where applicable
N	Answer "no," where applicable
I or ↑	Move the pointer up in *Spirolaterals*; trace north in Paths
J or ←	Move the pointer left in *Spirolaterals*
K or →	Move the pointer right in *Spirolaterals*; trace east in Paths
M or ↓	Move the pointer down in *Spirolaterals*; trace south in Paths
?	Get HELP

CARE OF DISK

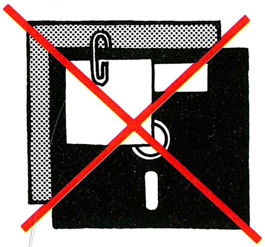
DON'T



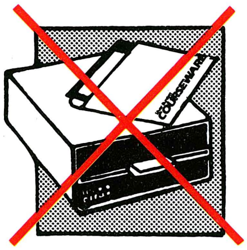
Don't touch the disk surface; hold the disk only by the label.



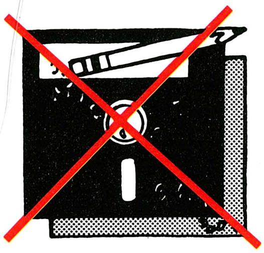
Don't bend the disk, fold it, or get it wet.



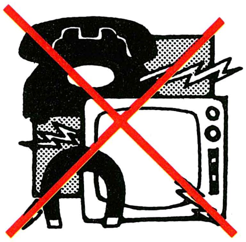
Don't use paper clips on the disk.



Don't place the disk on top of the monitor or on top of the disk drive.

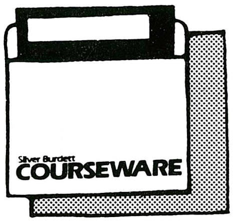


Don't write on the disk label with a ballpoint pen or a pencil; use a felt-tipped pen with light pressure.

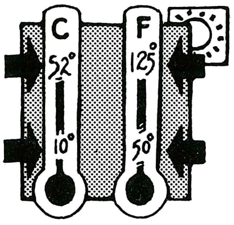


Don't put the disk where magnetic fields may damage it.

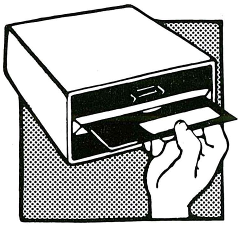
DO



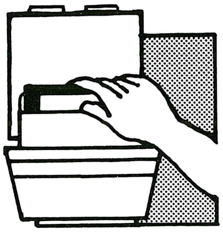
Do keep the disk in the protective envelope when it's not in use.



Do store the disk at 10°C to 52°C (50°F to 125°F) and keep it out of direct sunlight.



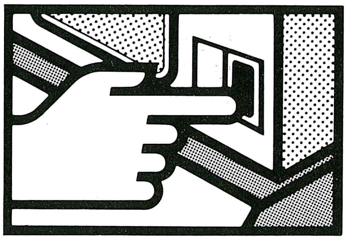
Do insert the disk into the disk drive carefully, with the label up and facing you.



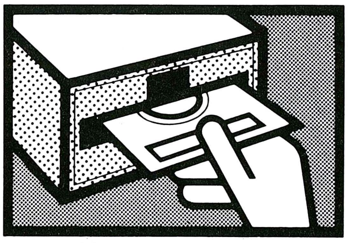
Do keep the disk away from chalkboards and other dusty areas.

QUICK START

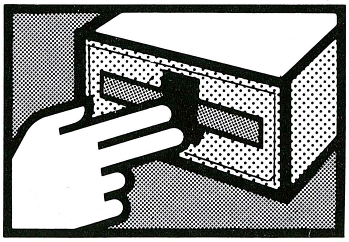
Apple® II Plus, //e, or //c



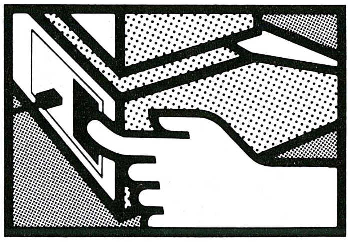
Turn on monitor.



Insert disk into disk drive, label side up.



Close disk drive door.



Turn on computer.

1 2 3 4 5 6 7 8 9 10—CP—95 94 93 92 91 90 89 88 87 86

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